The Institution of Engineers, Australia

CANBERRA DIVISION

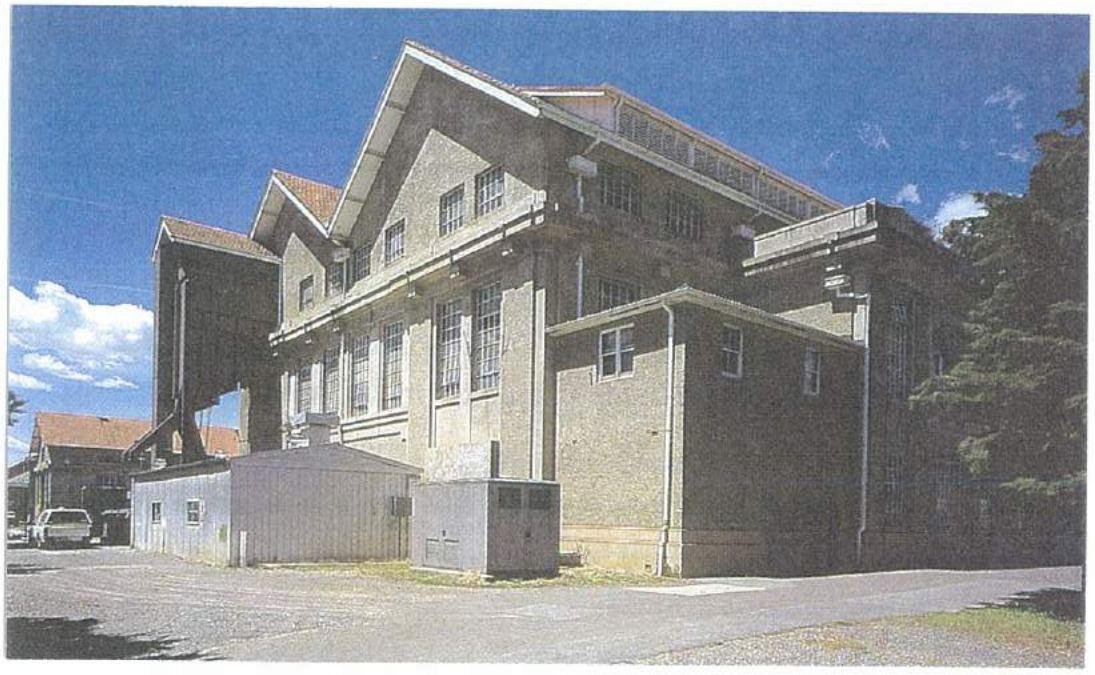
NOMINATION OF THE

KINGSTON POWER STATION

CANBERRA, AUSTRALIAN CAPITAL TERRITORY

FOR AN

HISTORIC ENGINEERING MARKER PLAQUE



Engineering Heritage Panel
June, 1997

PO Box E66 Kingston ACT 2604 Phone (06) 273 1314 Fax(06) 273 2051

File: C4.04

5 June 1997

The Institution of Engineers, Australia

CANBERRA DIVISION

Commemorative Plaque Sub-Committee
The Institution of Engineers, Australia
Engineering House
11 National Circuit
BARTON ACT 2600

NOMINATION FOR HISTORIC ENGINEERING MARKER

The following work is nominated for an Historic Engineering Marker plaque.

Name of Work

Kingston Power Station Building.

Location

Wentworth Avenue, Kingston, ACT - see map at Attachment A.

Owner

Government of the Australian Capital Territory/ ACT Electricity and Water Corporation (ACTEW).

Agreement to Nomination

The owner has agreed to this nomination - see Attachment B.

Access to Site

The building and its precinct have been the subject of negotiations between the Commonwealth and ACT Governments which will lead to development of the precinct for community purposes - see the recent newspaper article at Attachment C. The ACT Government has conducted a "Competition of Ideas" for the development of the precinct the results of which will be announced in late June 1997.

Under these circumstances, public access will be assured.

Future Care and Maintenance

Future care and maintenance is assured either as a public facility or as a continuing part of ACTEW property.

Name of Sponsor

The Engineering Heritage Panel, Canberra Division, The Institution of Engineers, Australia.

PO Box E66 Queen Victoria Terrace ACT 2600 Phone (06) 273 1314 Fax (06) 273 2051

Year of Construction

1915

Period of Operation

1915 to 1929 - full operation. Mid 1930s - full operation during period of reduced hydro electricity output from Burrinjuck Dam. 1929 to 1957 - stand-by operation. 1942 to 1945 - met the swinging load of the Belconnen Naval Transmitting Station. 1948 - full operation during a period of general power shortage in New South Wales. 1949 to 1957 - standby operation.

Engineering Heritage Significance

Technical/Scientific Value: At the time of its commissioning, the station was considered the most modern in Australia.

Historical Value: First permanent building constructed in the nation's capital, provided power to construction sites in the early days of the city's development.

Social Value: In the early days, the power station had some significance as a permanent landmark in the small Canberra community. Its steam whistle regulated the working day of the citizens and its lights provided a beacon for those returning home from the town of Queanbeyan late at night. It powered the houses of the few early residents and lit the sparse streets of the embryo capital. The outlet of the cooling water into the Molonglo River provided an ideal swimming hole. Power from the station enabled water to be pumped from the Cotter Dam to provide the community with a reliable water supply. With the development of the Kingston Foreshore Precinct, the Kingston Power Station will become a centre of social activity for Canberra's population.

Landscape/Townscape Value: The power station is a significant element of the Kingston townscape. Its size ensures it will remain a notable part of the Lake Burley Griffin landscape, an aspect which will be enhanced by development of the precinct for public purposes.

Rarity: There is only one Kingston Power Station.

Representativeness: The architecture of the building is typical of the early structures in Canberra including the Cotter Pumping Station, the Provisional Parliament House and the Canberra Hotel. Technically, it was considered state-of-the-art at its time of construction.

Contribution to Nation or Region: As a power station, it provided power for the establishment of the National Capital and later as a source of stand-by and peak load power for the NSW electricity grid.

Contribution to Engineering: Together with the Cotter River water supply works, the Kingston Power Station was the first major engineering undertaken in the building of the national capital. It reflected the foresight of the early planners in their selection of electricity to power the capital, at a time when the technology was still in the early stages of development in Australia. It is a symbol of the contribution of engineering to the planning and building of Canberra.

Persons Associated with Work: F W Clements MICE, MIEE, Chief Engineer and General Manager, Melbourne Electricity Company

John Smith Murdoch, Commonwealth Government Architect
Colonel P T Owen, Director General of Works, Department of Home Affairs
C R Scrivener, Director of Commonwealth Lands and Surveys
Walter Burley Griffin
King O'Malley, Minister for Home Affairs.

Integrity: Most of the operational equipment has been removed from the power station building but sufficient remains for the visitors to gain some appreciation of what the facility was like in its heyday. With the proposed development of the Kingston Foreshore Precinct, the building will be modified for community purposes. Whereas this may make its original use less obvious, the overall fabric of the building will be preserved. It will thereby continue to be a symbol of engineering's contribution to the development of the capital. The clever positioning of the Historic Engineering Marker plaque will ensure the community is reminded of this fact "forever".

Authenticity: Being purpose built and therefore unique, the Kingston Power Station is authentic in all respects.

Statement of Significance

The following statement of significance is based on two documents:

- the paper **ELECTRICITY, H A Jones, OBE, MIEAust** from the publication **Canberra's Engineering Heritage** - Attachment D; and

- the report to the ACT Government's Interim Kingston Foreshore Development Authority by Freeman Collett & Partners **Kingston Foreshore Site Cultural Mapping Study,** an extract appears at Attachment E.

The Kingston Power Station was the first permanent building constructed in the National Capital. It is a symbol of the far-sighted view of the capital's founders in that they opted for it to be all-electric when use of the technology was in its infancy in Australia. It played a major part in the development of the National Capital by providing:

- for electrical requirements during construction;

- a permanent general electricity supply;

- power for the water supply system.

The power station was the first major engineering work in the ACT and in many ways symbolises the contribution made by engineers to the establishment and development of the capital. At the time of its completion, the station was considered the most modern in Australia but such was the rate of advancement of the technology, it soon became outdated.

Although displaced as the prime supplier of power to the ACT by cheaper New South Wales hydro-electricity from Burrinjuck Dam in 1929, the powerhouse remained a valuable stand-by power source until 1957 when it was decommissioned.

The Kingston Power Station was recalled to service in the mid 1930s when the amount of power available from Burrinjuck was reduced because of fears regarding the safety of the dam wall. From 1942 until after the war, it met the swinging load of the Belconnen Naval Transmitting Station. It provided a valuable contribution to the New South Wales electricity grid during the years of general power shortage between 1948 and 1955.

The significance of the Kingston Power Station is therefore summarised as follows:

- for almost fifty years it was a valuable supplier of power - both prime and stand-by - to the ACT and the NSW power grid;
- it was the first permanent building erected in the national capital;
- it is a symbol of the contribution engineering has made to the construction and development of the national capital.

Proposed Plaque Text

HISTORIC ENGINEERING MARKER

THE KINGSTON POWER STATION

DESIGNED FOR THE FEDERAL GOVERNMENT'S DEPARTMENT OF HOME AFFAIRS AND COMPLETED IN 1915, THIS POWER STATION WAS THE FIRST PERMANENT BUILDING CONSTRUCTED IN THE NATIONAL CAPITAL. IT WAS A VALUABLE SOURCE OF PRIME AND STAND-BY ELECTRIC POWER FOR THE AUSTRALIAN CAPITAL TERRITORY AND THE NEW SOUTH WALES ELECTRICITY GRID FOR 47 YEARS. IT SYMBOLISES THE CONTRIBUTION OF ENGINEERING TO THE BUILDING AND DEVELOPMENT OF THE NATIONAL CAPITAL AND IS AN IMPORTANT PART OF THE CITY'S HERITAGE.

DEDICATED BY
THE INSTITUTION OF ENGINEERS, AUSTRALIA 1997

Proposed Location of the Plaque

At the time of submission of this nomination, the most appropriate location for the plaque would be at the main entrance in the south-west corner of the building. However, with the development of the station for community purposes, the best location for the plaque may be elsewhere.

It is the intention of the Engineering Heritage Panel to monitor developments and seek to position the plaque in a place where it will receive maximum public exposure for the foreseeable future.

Robert Breen
Nomination Coordinator

Robert Harvey
Chairman,
Engineering Heritage Panel

Attachments:

A. Map showing the location of the Kingston Power Station.

B. Owners letter of consent to nomination.

C. Article "Kingston-Acton land swap now complete", **The Canberra Times**, Friday May 30 1997

D. Paper **"Chapter Six, ELECTRICITY, HA Jones, OBE, MIEAust."** from **Canberra's Engineering Heritage, Second Edition**, Canberra Division, The Institution of Engineers.

E. Paper **2.2 Power for the Federal Capital**, extract from **Kingston Foreshore Site Cultural Mapping Study Volume 1 : Cultural Mapping, for The Interim Kingston Foreshore Development Authority by Freeman Collett & Partners, Conservation Architects & Planners, Canberra.**

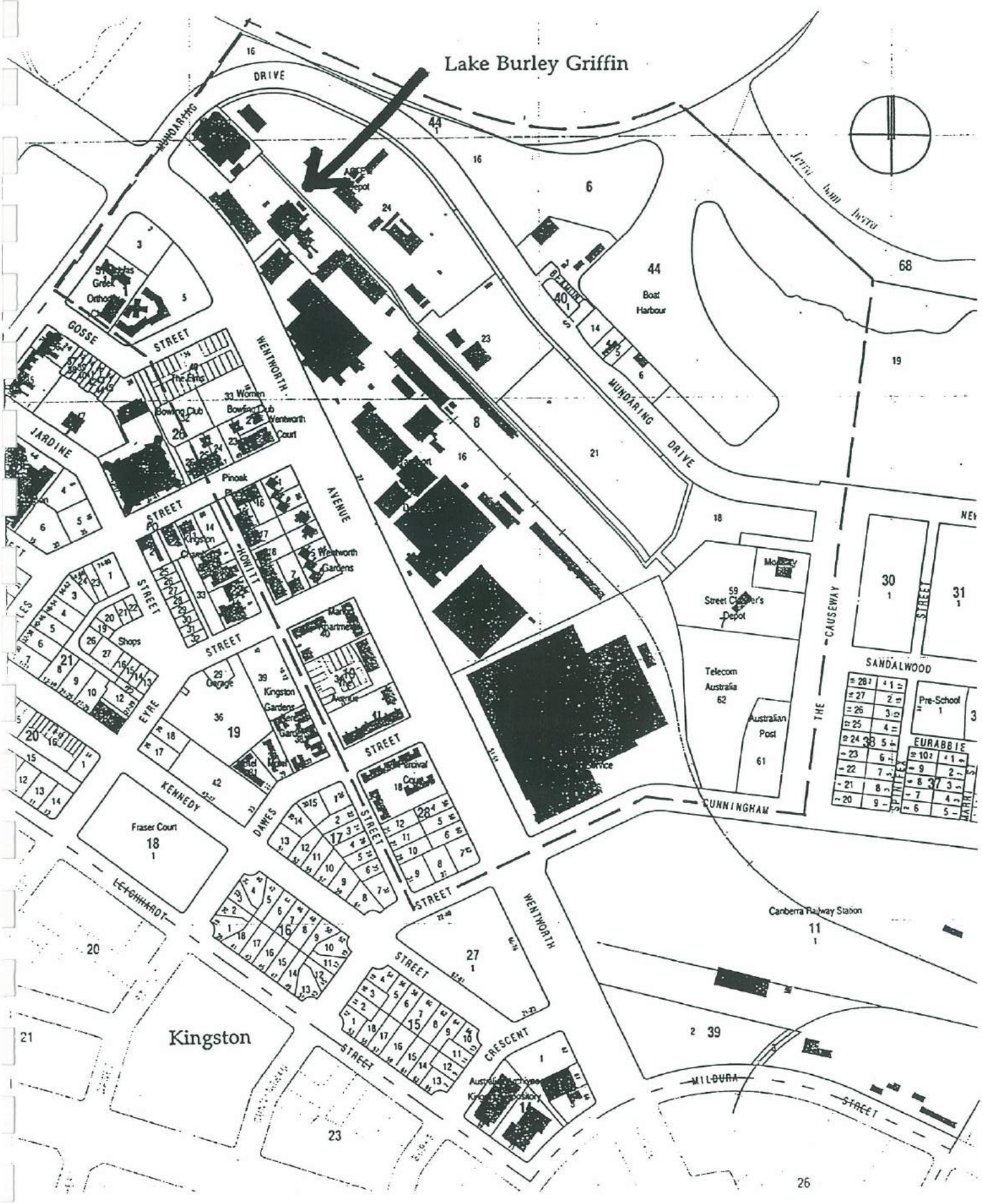


Figure 1 Kingston Foreshore Site Plan and Location Map

ATTACHMENT B

Kate Carnell MLA

Chief Minister
Treasurer
Minister for Health and
Community Care

Member for Molonglo
Australian Capital Territory

Mr Bob Harvey
Chairman, Canberra Division Heritage Panel
The Institution of Engineers, Australia
PO Box E66
KINGSTON ACT 2604

Dear Mr Harvey

I refer to your letter of 27 February 1997 regarding the nomination of the Kingston Power Station for an Historic Engineering Marker Plaque.

I am most pleased to support the nomination.

As you may be aware, the ACT Government is conducting a national design competition for the Kingston Foreshore to generate innovative design concepts and facilitate the transition of the area to a vibrant mixed use water front precinct enjoyed by residents and visitors alike. This is being organised and conducted by the Interim Kingston Foreshore Development Authority (IKFDA) and the competition process has been supported by the Institution of Engineers Australia.

The Competition Brief emphasises the heritage significance of the Kingston Power Station and the preparatory studies undertaken by the IKFDA confirm the findings of the Institution's Statement of Significance.

The recognition of this significance through the Institution's Plaquing Programme will serve to further enrich the community's experience of the site in the future. Thank you for the opportunity to lend my support to this initiative.

Yours sincerely

Kate Carnell

Kate Carnell MLA
Chief Minister

24 MAR 1997

ACT Legislative Assembly,
London Circuit, Canberra ACT 2601
GPO Box 158, Canberra ACT 2601

Phone (06) 205 0101 Fax (06) 205 0399

ATTACHMENT C

Kingston-Acton land swap now complete

By BRENDAN NICHOLSON

The final stage in the Kingston-Acton land swap has occurred with the Federal Government taking national control of the Acton Peninsula site and handing the Kingston lake shore development land to the ACT.

Formal notices in the *Commonwealth Gazette* marked the completion of a process which began two years ago with a verbal agreement between former prime minister Paul Keating and ACT Chief Minister Kate Carnell.

Mrs Carnell said the two sites had now been unlocked so major projects could proceed on them.

The Federal Government would build the National Museum of Australia and the Institute of Aboriginal and Torres Strait Islander Studies on Acton. Work is well under way with the demolition of the old Royal Canberra Hospital buildings.

Preliminary work on the Kingston site will begin by the end of the year. A design competition is under way for a mixed-use development that will provide a lively tourism, entertainment and cultural precinct on the lake shore.

"Without the land swap, Acton Peninsula would have remained unused and the subject of ACT-Commonwealth bickering," Mrs Carnell said. "Kingston would have remained an industrial dump despite its outstanding location and potential to become one of Canberra's jewels."

Chapter Six

ELECTRICITY

H.A. Jones, OBE, MIE Aust.

H.A. Jones is well qualified to write the history of electricity supply in the ACT. He joined the Federal Capital Commission in 1928 as a Cadet and was actively associated with all phases of electricity supply in Canberra from those early years right through to his retirement in 1975: even when away he kept in touch.

After a break in 1943 to carry out wartime defence work, he returned to the Department of Works, Canberra, in 1949 as senior electrical engineer, and on the retirement of Mr W.E. Gray, became supervising electrical engineer. In 1953 he was appointed engineer manager, Canberra Electricity Supply, Department of the Interior, and with formation of the ACT Electricity Authority in 1963 he became its first Chairman, a position he held until retirement.

THE first permanent building in the National Capital was the power station at Kingston. It was designed by the Department of Home Affairs in 1912 and completed in time to generate electricity in August 1915. The new building was the realisation of the dream of the Capital's founders that the city should be all-electric, which was a far-sighted view early in this century when electricity had only recently been made available in Sydney and Melbourne on a restricted basis.

The Seat of Government Acceptance Act 1909 had made provision for the supply of electricity to the Capital by hydro-electric power utilising the abundant waters of the Snowy Mountains in New South Wales. The Act stated:

> 'The State shall grant to the Commonwealth without payment therefor the right to use the waters of the Snowy River and other such rivers as may be agreed upon or in default of agreement may be determined by arbitration for the generation of electricity for the purposes of the Territory and to construct the works necessary for that purpose and to conduct the electricity so generated to the Territory.'

Development of a Snowy River hydro-electric scheme did not begin until 1949 but in 1911 steam power generation was seen as the means of supplying electricity to the new Capital. On 10 July of that year, Mr F.W. Clements M. Inst. CE MIEE, Chief Engineer and General Manager, Melbourne Electric Supply Co., submitted a report to Colonel P.T. Owen, Director General of Works, Public Works Branch, Department of Home Affairs on 'A General Electric Supply Scheme for the Proposed Federal Capital at Canberra'. In this report Mr Clements outlined a scheme which would be suitable for:

(a) Electrical requirements during construction of the Capital,
(b) the permanent general electric supply,
(c) the provision of power for the proposed Water Supply Pumping Station at the Cotter River.

A steam power station was specified and the recommendations of his report were followed. His basic recommendation to use alternating current three phase four wire fifty cycles with a generating voltage of 5,000-5,500 volts was far sighted in those days, especially as he was asked to

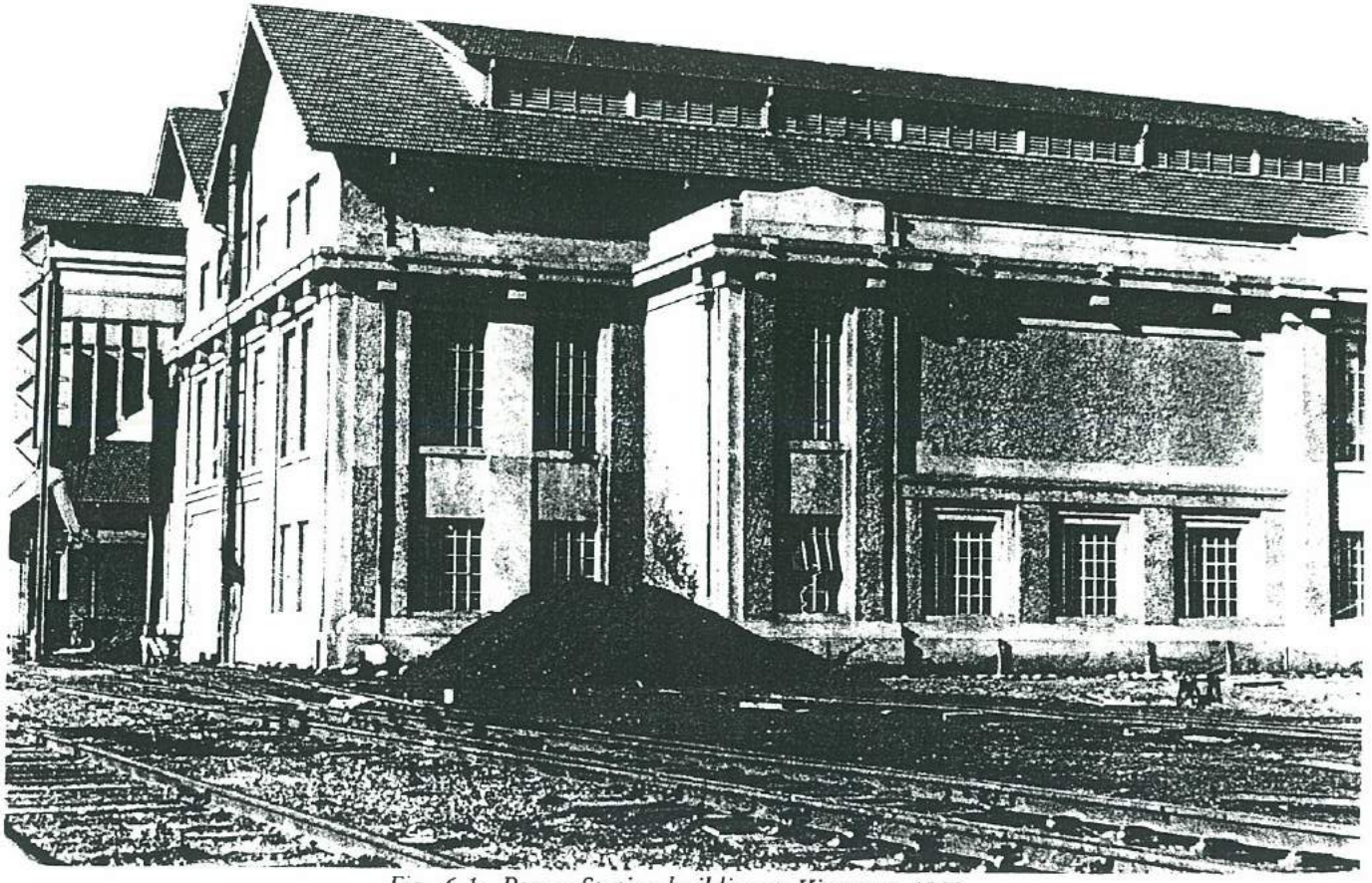


Fig. 6.1: Power Station building at Kingston, 1915.

Fig. 6.2: Weir for cooling water at Power Station near the present Kings Avenue Bridge. Footbridge removed and concrete roadway added later. Photo — A.E. Minty 1959.

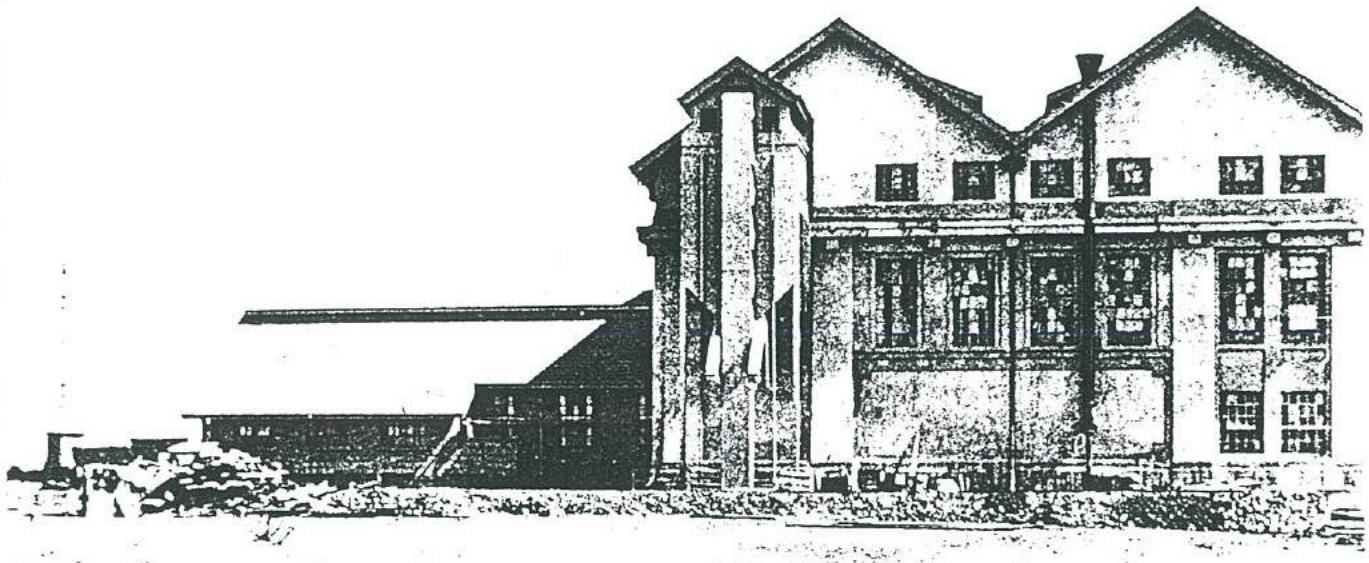


Fig. 6.3: Rear of Power Station building Kingston showing economiser room and original stack 1915.

recommend an electric supply for a City of 25,000 inhabitants and having regard to the development of electric supply at that date.

It was decided to build a power station at Interlake Avenue (Wentworth Avenue, Kingston) adjacent to the Molonglo River where a small dam was built to provide a source of cooling water for the condensers of the steam generating sets. The building, designed and constructed by the Department of Home Affairs, was commenced in 1912 and started generating electricity in August, 1915. The building allowed for the generating equipment recommended by Mr F.W. Clements with assistance on the steam side from Mr Christie, a Consulting Marine Engineer from Sydney.

The power station was not built on the site nominated by Griffin in his prize winning plan but on a site selected according to the Departmental Board's plan which was substituted for Griffin's and to which construction of the City was then committed. Griffin had shown the power station to be on the northern shore of his East Basin, below Russell Hill. Subsequently, at the 1916 Royal Commission of Inquiry, Griffin did not object to the location chosen by the Board on the southern shore of the Molonglo River.

The Department decided to build a solid steel and concrete building with brick curtain walls. One and a half million bricks were made and put to grass but unfortunately they were made by the dry press process unsuitable for Canberra's shale and they disintegrated. The curtain walls were then made of unreinforced concrete made with river gravel.

The power station at the time was considered to be the most modern in Australia, but progress soon made it old fashioned. However, it had some eminence in the early days as a permanent land mark, and late at night its lights served as a beacon to guide many Canberra folk home from Queanbeyan late at night.

When a group of houses was built in a suburb most of the roads were constructed and temporary street lighting was installed along the footpaths included in the road reservation. These were open street lights on wooden poles about 95 metres apart and were to be replaced when the street trees grew. After viewing these illuminations from Red Hill one night a visitor remarked to the Secretary of the Prime Minister's Department that it was a wonderful sight. "Yes. Paris at night and Arabia in the morning", answered the bureaucrat. Press Gallery journalists who didn't like Canberra, called it 'the only illuminated cemetery in the world!'

The few early residents in houses had electricity provided at a reasonable flat rate of 7s.6d. per month from about 1916 to 1922 when metering was installed and a tariff struck.

The train from Queanbeyan stopped outside the power station until the railway station was built, and the power station even made ice packed in sawdust which was delivered by horse and dray to the Bachelor's Quarters and houses at Acton.

The total cost of the power station was £76,861 which included £37,501 for the plant, a large expenditure in those days.

The first installation of generating equipment in the power station comprised:

Two Bellis and Morcom triple expansion engines running at 250 rpm and exhausting into condensers but each fitted with flanges to render them suitable later to exhaust into an exhaust turbine. These were direct coupled to Brush Alternators of 600 kW capacity at 0.8 power factor lagging and generating 5,000/5,500 volts, three phase 50 cycles.

One Robey-Hall twin cylinder steam engine direct coupled to a 150 kW alternator was installed to be used at periods of very light load.

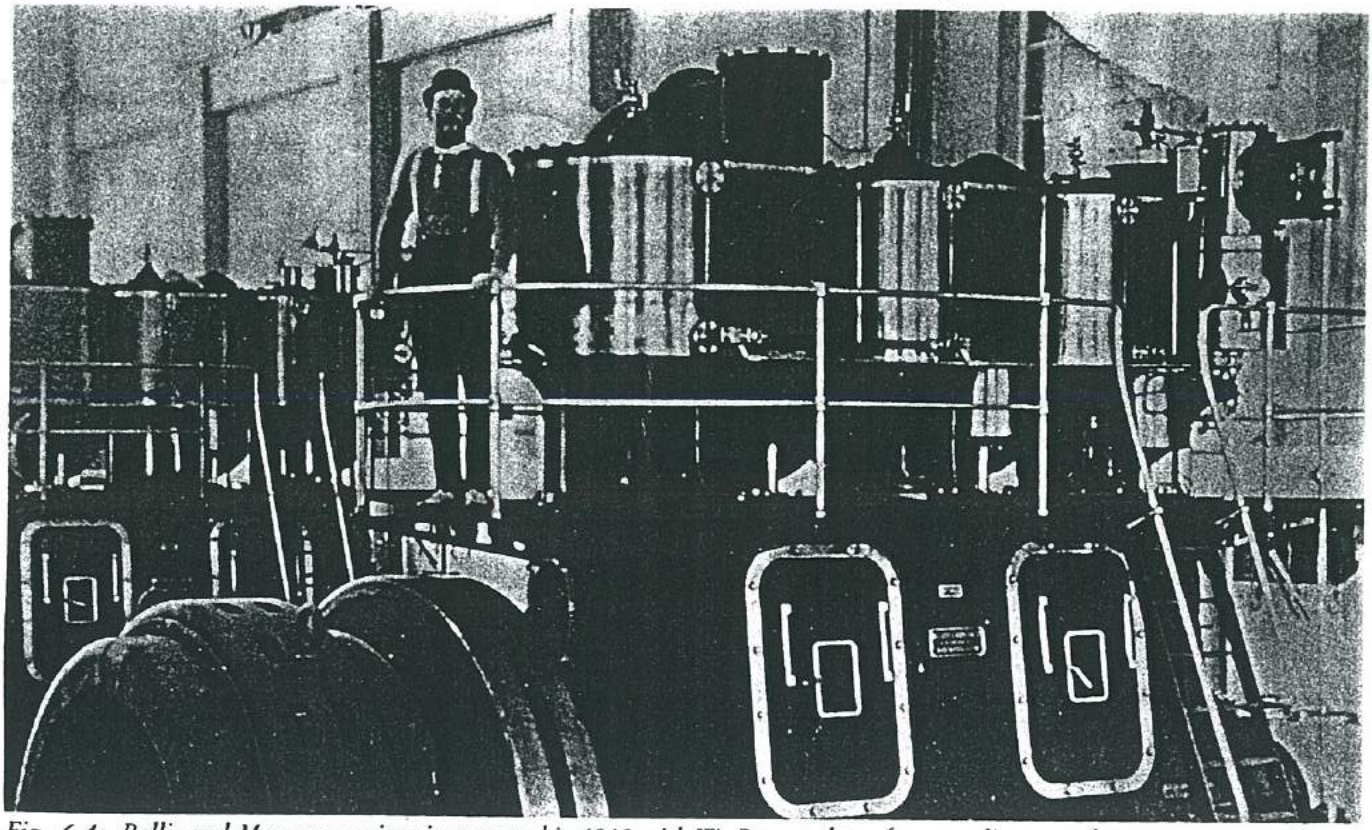


Fig. 6.4: Bellis and Morcom engines just erected in 1915 with W. Brown, later foreman linesman for many years. Photo — Bert Brown.

The Boiler Plant comprised four double drum Babcock and Wilcox boilers with chain grate under fired stokers and with superheaters. Each boiler would evaporate 15,000 lb of water per hour at a pressure of 180 lb per square inch superheated to 550° F.

Induced draft fans were provided and a Greens Economiser raised the feed water temperature from 140° to 260° F.

It is worth noting that the original 5,500 volt main switchboard installed in 1915, despite the fact that it was outmoded and could not handle the available fault current, remained in service for about forty years by necessity. Switchgear fires were not unknown but they were extinguished and it carried on until it could be replaced.

Canberra's first supply of public electricity generated at the Eastlake (Kingston) Steam Power Station from August 1915, was conveyed to Duntroon and Acton on 5,500 volt overhead lines and in 1916 to the Brickworks at 5,500 volts and to the Cotter Pumping Station at 11,000 volts. The first Brickworks motors were run from 11 October, 1916, and the first Cotter Pump on 16 October, 1918.

A large length of power line for construction mainly of the main sewers was also installed.

The general 5,500 volt overhead lines were mounted on very large swan neck pins with American "Locke" 6,000 volt insulators and with an overhead earth wire. In the middle thirties, this construction was changed to three feet equilateral spacing with a pole top bracket and Australian insulators. The above types of construction were adopted to reduce tree interference because of the narrow clearance required.

On 22 October, 1927 a BTH Curtis type turbo-alternator was connected to the main steam range. This ran at 3,000 rpm and generated 1,500 kW at 0.8 lagging power factor, at 5,500 volts 50 cycles. At this time the Robey-Hall machine was discarded.

Although the addition of this turbine enabled electricity to be produced more economically and in fact the retail tariff was reduced, the Southern Electric Supply Branch of the NSW Department of Public Works submitted a proposition to the Federal Capital Commission to provide electricity from Burrinjuck at an even cheaper rate. This was accepted and some 80 miles of 66 kV three phase line was constructed by the Southern Electric Supply from Burrinjuck Hydro-Electric Station to Canberra.

At the irrigation dam at Burrinjuck Lake the Public Works Department of New South Wales had installed two 5,000 kW hydro-electric alternators for which, without Canberra, they had insufficient loading in the south of New South Wales. Canberra's supply was taken from Burrinjuck from 1929 to 1938 on a single radial line nearly 80 miles long with the local steam plant remaining as standby.

In the middle thirties, doubt arose regarding the strength of the wall of Burrinjuck Dam and the water level was lowered while remedial work was carried out.

With reduced generating ability there, the Canberra Power Station and others in southern NSW, such as Yanco, generated at full capacity. Also two 1,500 kW Brush-Ljungstrom turbo generators which had been taken out of Port Kembla Power Station were installed at the Canberra Power Station, together with two Babcock and Wilcox boilers of 20,000 lb/hour (9,100 Kg) capacity at 200 lb per square inch (1,400 kPa) and 600° F (316° C) Superheat. These were commissioned and on the line on 28 February, 1939. The total generation from Canberra paralleled with the NSW Grid was 5,100 kW. In late 1938, a second 66,000 volt line from Goulburn was connected to the Canberra Switchyard, thus connecting Burrinjuck and Port Kembla Power Stations.

This was later strengthened by a 132 kV line paralleling it between Goulburn and Burrinjuck.

The steam plant at Kingston ran in this fashion generating up to 5,000 kW, regularly at first and later sporadically as required until early 1942 when it was no longer required for grid purposes as Burrinjuck with doubled capacity was then available.

From May 1942 the BTH 1,500 kW turbo alternator ran 20 hours per day separately from all other load, to supply the swinging load of a very large transmitter at Belconnen Naval Station at the very close voltage regulation required

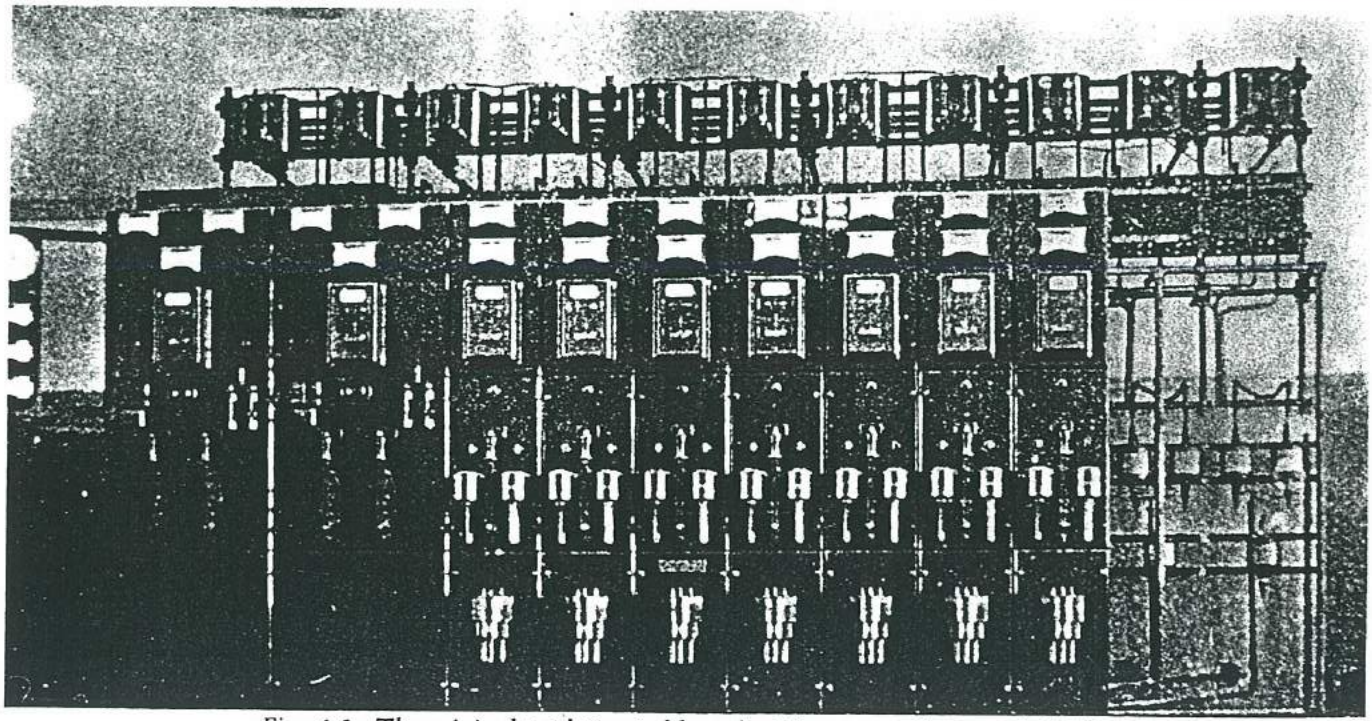


Fig. 6.5: The original 5.5 kV switchboard at Kingston. Photo — ACTEA.

and did so until after the war. This was considered necessary as spare valves were limited and unobtainable during the war and the Navy did not wish to subject them to the fluctuations due to lightning transients on a grid system traversing the whole of New South Wales.

All power station plant was again pressed into use in 1948 due to the general shortage of generating plant in New South Wales, combined with the rapidly increasing demand for electricity. It ran regularly until 1955 and sporadically until 1957 when it was closed down. Prior to this, in 1947, one Bellis and Morcom generator was sold and installed at the Mount Burr Forestry Mills, South Australia where it produced both electricity and exhaust steam for the timber drying kilns.

All existing machinery was sold for scrap in 1965 but the building which is a mass of concrete still remains near

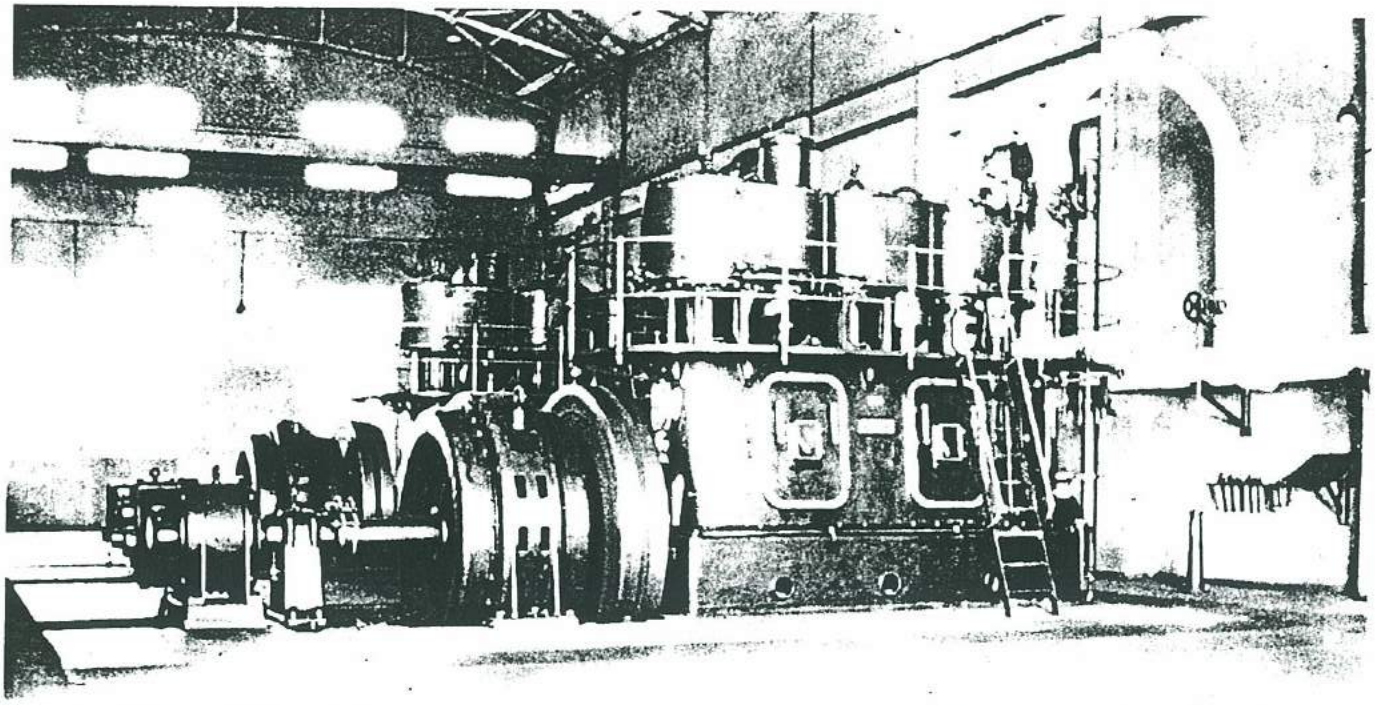


Fig. 6.6: The two Bellis and Morcom engines driving Brush alternators before the BTH alternator was installed. Photo — ACTEA.

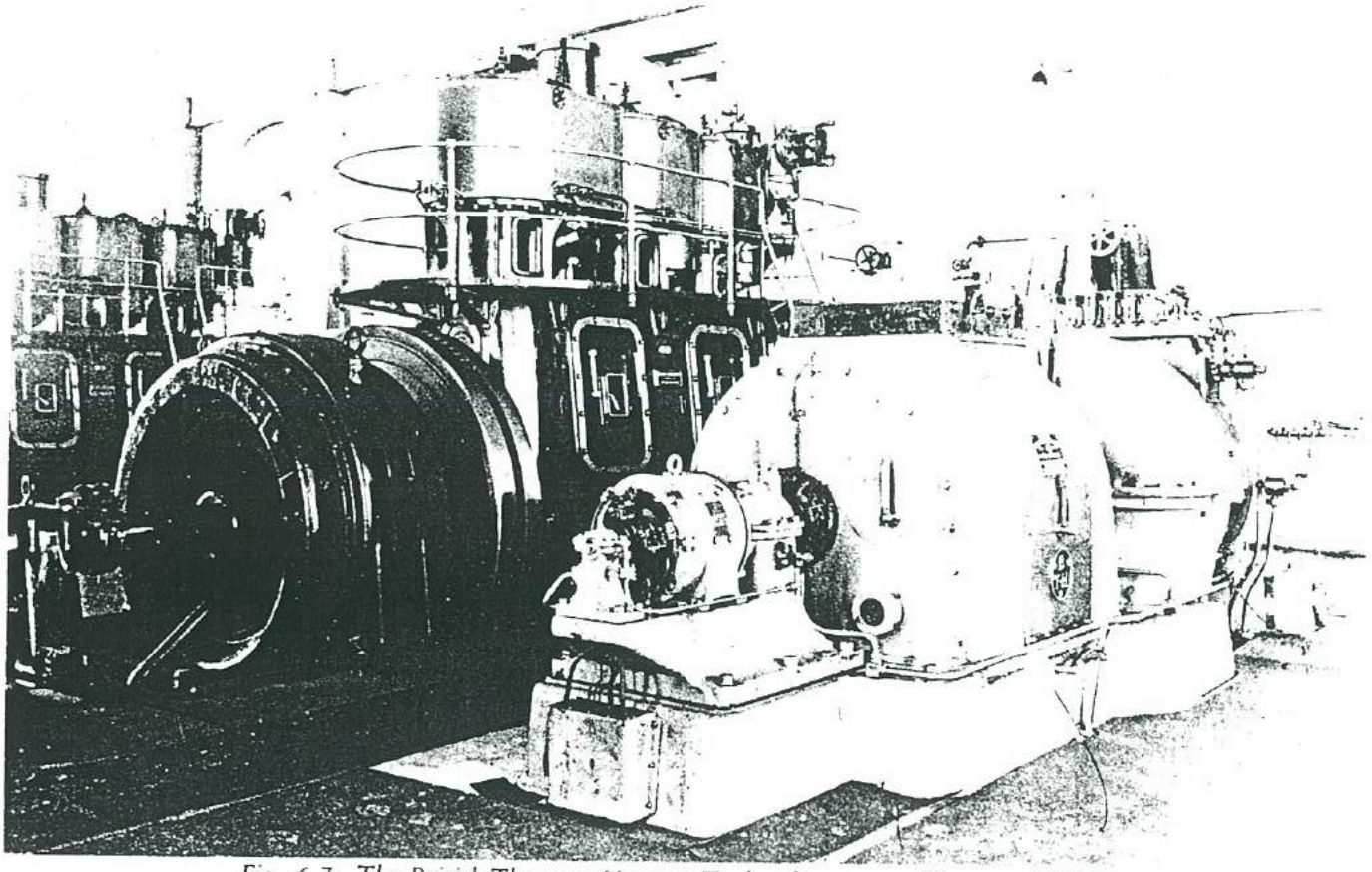


Fig. 6.7: The British Thomson Houston Turbo alternator. Photo — ACTEA.

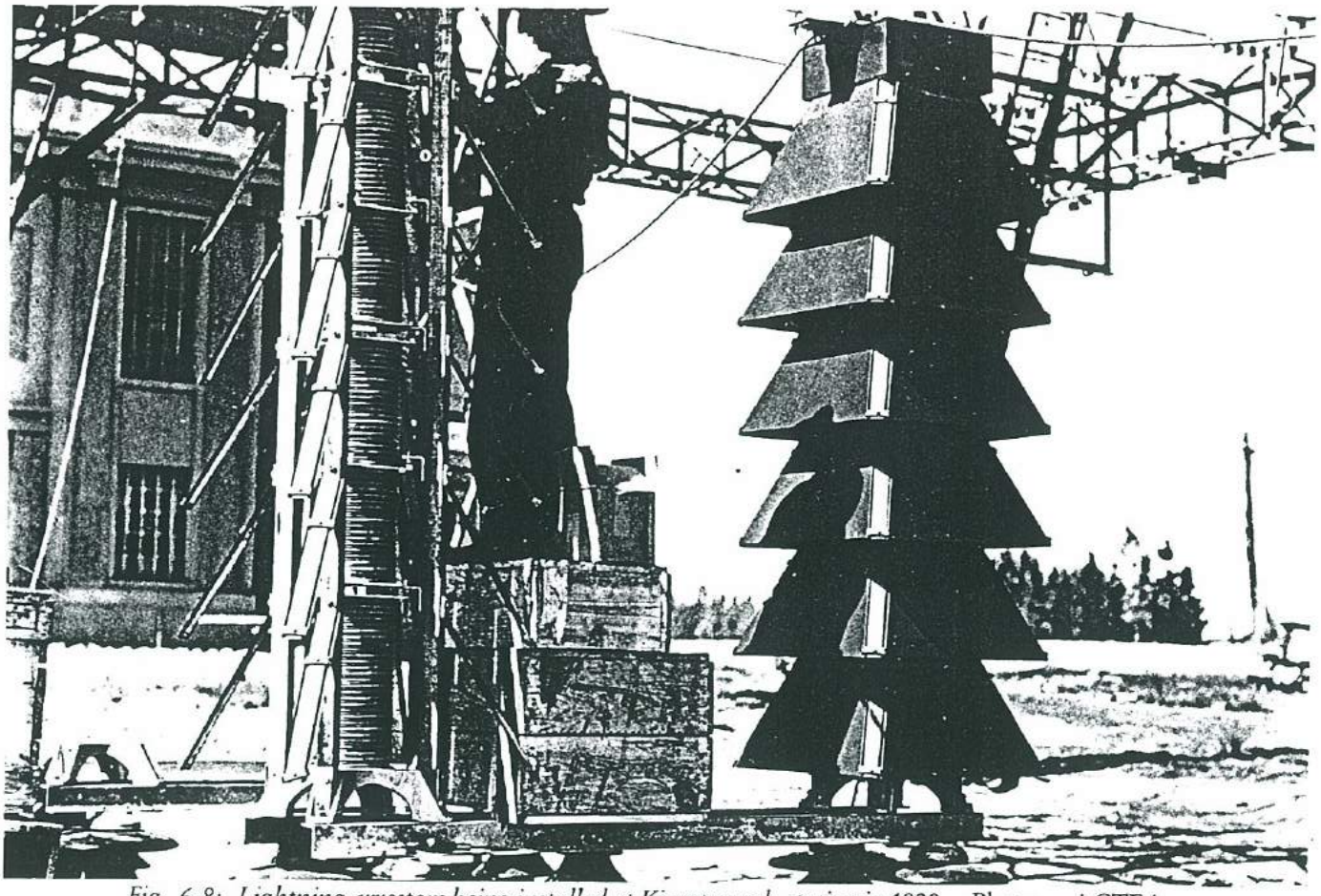


Fig. 6.8: Lightning arrestors being installed at Kingston sub-station in 1928. Photo — ACTEA.

Wentworth Avenue, Kingston where it is used by the Electricity Authority for a variety of purposes.

Diesel Power Station, Kingston

About 1950, the Electricity Commission of NSW, which was suffering a shortage of generating plant and transmission capacity to serve New South Wales requiresments, installed a number of "packet" stations, both steam and diesel, throughout New South Wales and as part of this project in 1953, installed a diesel generating station at Kingston which comprised four Harland and Wolfe diesel engines direct coupled to Brush generators each of 1,250 kVA capacity generating at 3,300 volts. This was stepped up to 11,000 volts and connected to the temporary 11,000 volt busbars at the Kingston substation.

This station, which as well as the steam power station, generated from 1953 to 1956, was sold to the Commonwealth in 1960 and remains there to be used as a standby in the case of total shut down. There are only three diesel alternators left, so the capacity of 3.5 MW compared with Canberra's peak load of about 500 MW, could only be used for very minor essential loads.

Bulk Supply and Zone Substations

Prior to 1 September, 1929, when it was put into service, the Public Works Department of NSW designed and constructed a bulk substation at Kingston to receive, control and step down the supply of 66,000 volts from Burrinjuck.

The substation comprised two banks each with three single phase transformers to Berry (British Electric Transformer Co.) manufacture of 600 kVA capacity each and had a ratio of 66,000/6,600 volts.

The output from each regulator was fed through a Berry 1,800 kVA Auto transformer star connected 6,600/5,500 volts ratio, thence through two GE (America) Auto-reclosing OCB's in the Power House basement with a metering panel to the Federal Capital Commission's duplicate 5,500 volt open busbar in the engine room, from which the local 5,500 volt feeders emanated.

On the 66,000 volt side the transformer banks were protected by very long liquid fuses mounted on the steelwork of the sub-station. These were replaced by two Metro-Vick bulk oil three phase circuit breakers.

As an indication of the size of the undertaking at that time, the maximum demand of the Canberra load dropped from 1,200 kVA to 1,174 kVA for 1930-31 but was still the largest load on the Southern NSW system.

In late 1938 a 66,000 volt line from Goulburn tied in with the Burrinjuck line at Canberra Substation thus connecting Burrinjuck generating station with that of Port Kembla. In 1938 also, BTH type JB429 bulk oil circuit breakers were fitted to the terminations of the 66,000 volt lines from Burrinjuck and Goulburn. Later, at the end of 1938, a third circuit breaker of the same type was fitted to an outgoing 66,000 volt overhead line which fed Captains Flat.

A seven panel 11 kV Westinghouse truck switchboard was installed in a brick building at the eastern end of the Kingston Substation in 1938 and was gradually connected to the 6.6 kV system until it comprised the following panels:

Brush-Ljungstrom Generators 5 and 6
Transformer Secondaries No. 1 and No. 2
Canberra Load (to Auto Transformers) No. 1 and No. 2
Canberra Load No. 3 (to Cotter Line Auto Transformers)

The bulk metering was then transferred from the 5,500 volt busbars to the 6,600 volt busbars.

In November 1940 the No. 1 bank of 3 × 600 kVA single phase 66/6.6 kV transformers was replaced by a Crompton Parkinson Tap Changing Transformer 5,000 kVA capacity 66/6.6 kV ratio.

In 1946, the remaining bank of single phase transformers (No. 2) was replaced by an AGE tap changing transformer of 7,500 kVA capacity.

These remained in service until 14 October 1953 when both the main 66,000/6,600 volt tap changing transformers were replaced by two English Electric 10 MVA 66/11 kV tap changing transformers and our supply voltage changed to 11 kV from 6.6 kV.

With the demand for electricity increasing at a very high rate, the Electricity Commission of New South Wales built a large substation in 1957 at Oaks Estate near Queanbeyan to cater for Canberra, Queanbeyan and Captains Flat. It was of 120 MVA capacity and 132/66 kV ratio, reducing the voltage from the 132 kV lines from Yass and Cooma.

In 1957 one of the 10 MVA Main Transformers at Kingston was removed and two 15 MVA English Electric 66/11 kV were installed, ASEAP Small Oil Content Circuit Breakers controlling the primary side of the new transformers. The Electricity Commission of NSW also changed the incoming BTH 66 kV Incoming Circuit Breakers with ASEA Circuit Breakers of higher fault capacity. These were changed in 1956, 1957 and 1961.

In the early fifties, Canberra engineers saw the necessity for a number of zone sub-stations and decided to build a 66 kV ring which involved taking supply at Oaks Estate Substation at 66 kV, running initially two lines from there to Kingston Substation which Canberra Electric Supply had bought from the Electricity Commission of NSW. The lines were constructed and put in service in May, 1959.

In 1959, Canberra Electricity Supply took over the Kingston Substation and in 1961 replaced the remaining 10 MVA Main Transformer with a 15 MVA Transformer of Tyree Manufacture. In the same year the first of the new Zone Substations at North Ainslie was built and commissioned in May, 1961.

An 11 kV switchroom at the western end of the Kingston switchyard had been built since 1948 but the 11 kV switchgear was not designed and installed until 1960. At that time a gradual changeover of 11 kV feeders occurred until the outdoor 11 kV busbar and its plethora of cubicle circuit breakers were eliminated. The switchroom was extended to accommodate additional 11 kV switchgear and the switchboard now comprises 32 panels.

In 1965 a fourth 15 MVA transformer of Tyree Manufacture was added and all transformers were fan cooled, giving a total capacity of 74 MVA with 24-11 kV feeders emanating from it.

A fifth transformer of 19 MVA capacity was moved in from North Ainslie Substation in 1974 and remains as a standby for the other four.

North Ainslie 66 kV Zone Substation

This substation was built on land at the corner of Majura Avenue and Officer Crescent, Ainslie. The first stage was completed and commissioned in May 1961 and comprised 2-15 MVA Tyree tap changing transformers of ratio 66/11 kV.

On the 11 kV side there was an open busbar with a centre tie circuit breaker feeding to a cubicle type outdoor switchboard of E.C.N.S.W. pattern manufactured by Standard Waygood and comprising 13 panels.

To feed this substation a 66 kV overhead line was constructed from Kingston Substation to North Ainslie Substation using the original (1929) double circuit Burrinjuck and Goulburn poles across the river flats to the rear of Mt Ainslie and thence new construction. A further 66 kV line was built from North Ainslie Substation along Phillip Avenue to join the original Burrinjuck Line behind Crace Hill.

In 1962 the 66 kV overhead line ring was completed from Crace Hill behind Black Mountain through Woden and back to the EC NSW Substation at Oaks Estate. The line conductor was steel cored aluminium of 0.2 inch copper equivalent with one conductor per phase and totalled about 32 circuit miles in length.

In 1963 an additional 15 MVA Tyree tap changing 66/11 kV transformer was connected and in 1965 fan cooling was fitted to all transformers giving a total capacity of 57 MVA.

66 kV Woden Zone Substation

The Woden Zone Substation was located near the corner of Devonport and Heyson Street, Lyons and was commissioned in 1964 with two Tyree 15 MVA tap changing transformers which were fan cooled in 1965 giving a total capacity of 38 MVA. A control building on the site housed an 11 kV Westinghouse Switchboard with 17 feeders.

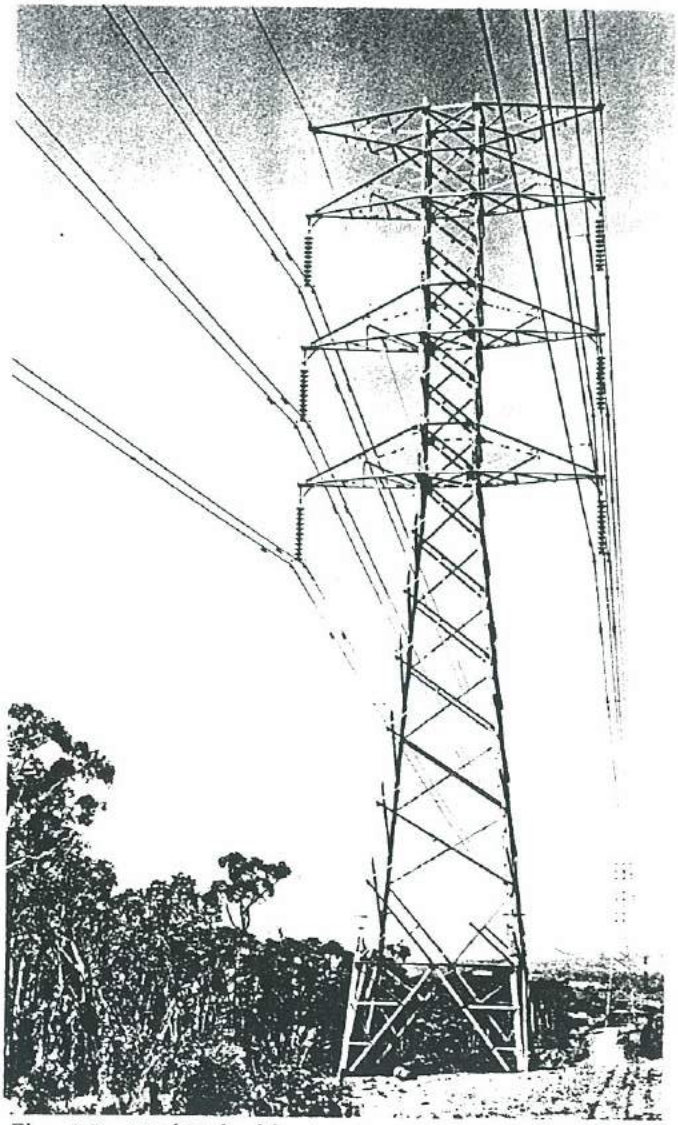


Fig. 6.9: 132 kV double circuit transmission tower. Photo — ACTEA.

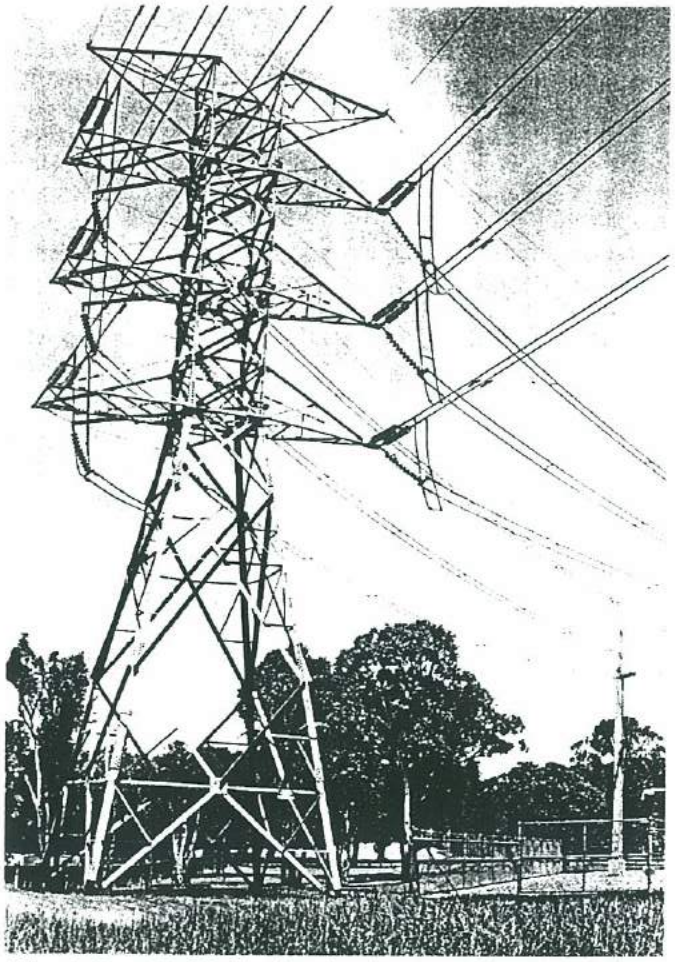


Fig. 6.10: 132 kV double circuit terminal tower. Photo — ACTEA.

Change of Sub Transmission Voltage from 66 kV to 132 kV

Despite all the above work which was carried out to maintain supply and keep up with the demands for electricity, it was evident that the rate of increase of demand, always much higher than that of population, would require drastic action to cope with projected future requirements so in the early sixties, consultation with the Electricity Commission of New South Wales resulted in the decision to built a 330/132 kV Substation at Weetangera district, now Charnwood. This substation would have an initial capacity of 750 MVA and a final capacity of 1,500 MVA occupying a land area of 69 acres (28 ha). Canberra would then take bulk supply from them at this centre at 132 kV, retaining the 66 kV bulk supply point at Oaks Estate, until all Canberra load could be transferred to the 132 kV bulk supply point.

The ACT Electricity Authority commenced design of a 132 kV system with some novel features. To preserve the amenity by using a minimum number of 132 kV lines, it was decided to use tower lines of pleasing proportion and the highest capacity practicable. They were 2-0.5 square inch (322 mm²) copper equivalent SCA (Moose) conductors per phase, each line capable of transmitting 500 MVA.

Every care was taken in close consultation with officers of the National Capital Development Commission to reduce the visual impact of the 132 kV lines as much as possible, and to co-ordinate their location with the general planning as known at that time. Even tower design was chosen to present a pleasing aspect.

Two lines were built in 1967, emanating from the Electricity Commission of NSW 330 kV substation, one along the Molonglo River Valley to Woden and one through the as yet unbuilt Belconnen Valley to a substation

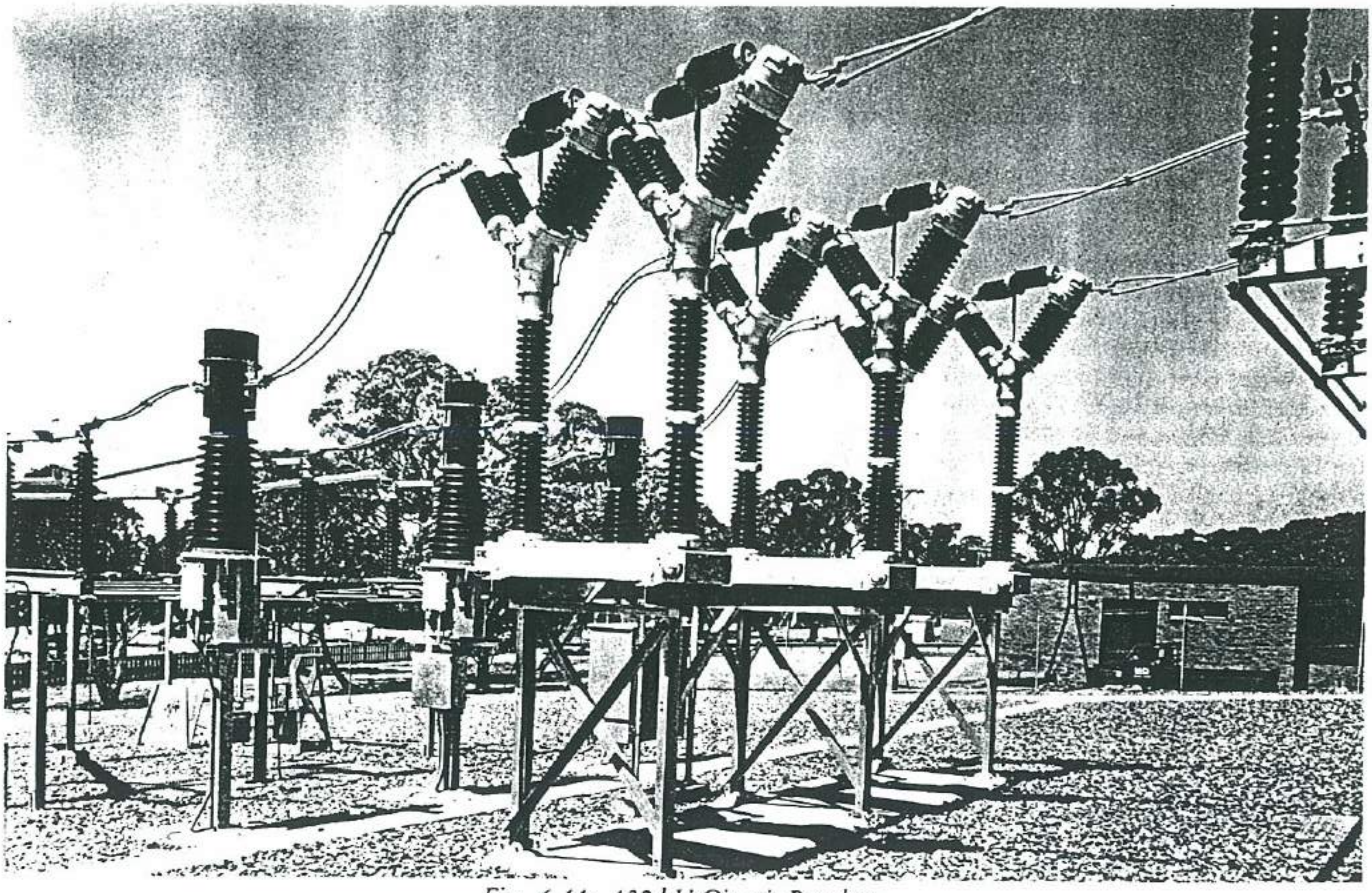


Fig. 6.11: 132 kV Circuit Breaker.

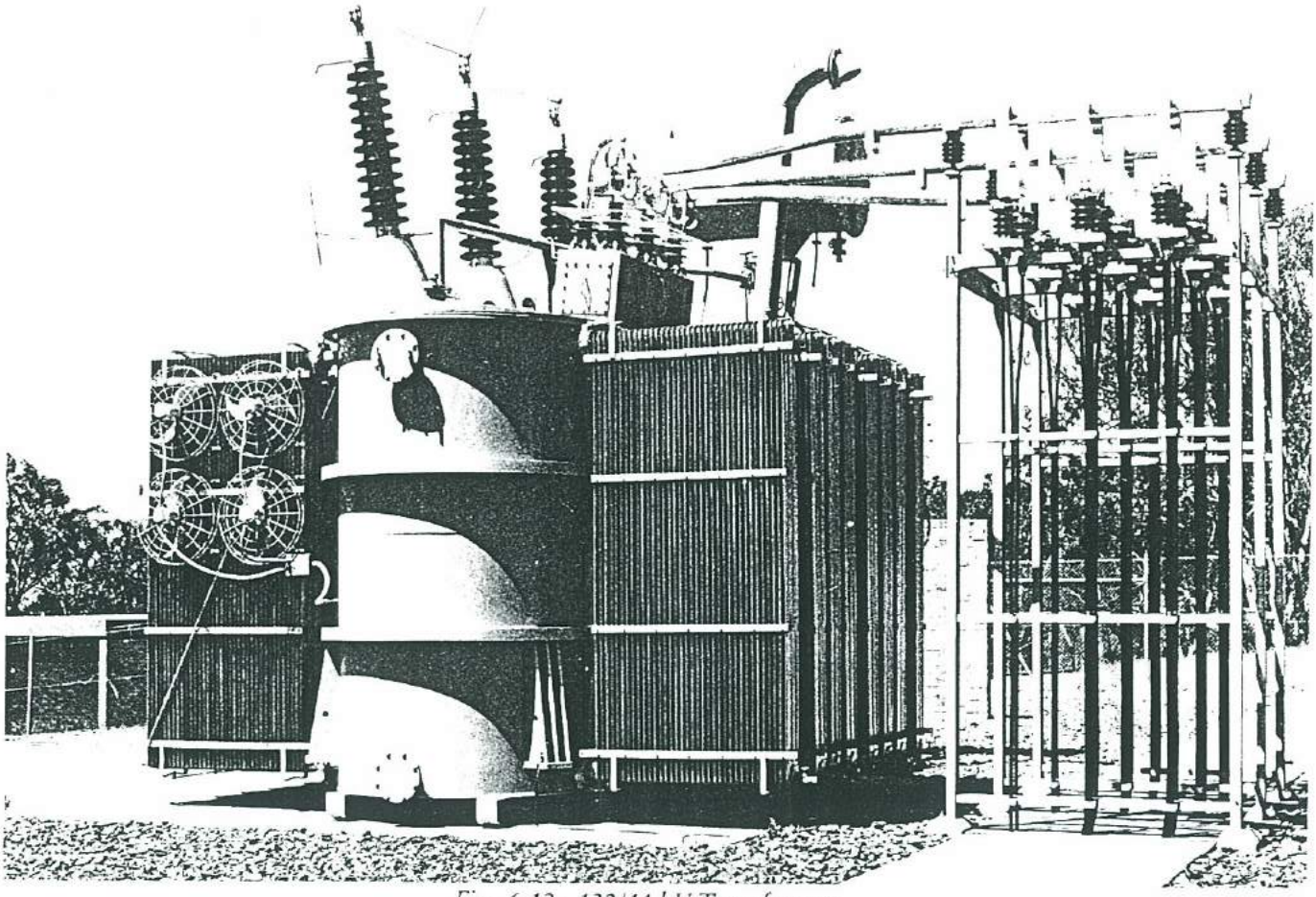


Fig. 6.12: 132/11 kV Transformer.

at the foot of Black Mountain and thence to Woden, a total route distance of 26 miles (42 km).

Main Zone Substations 132/11 kV

Having decided to take supply at 132 kV which was then the highest sub-transmission voltage used in Australia, a further step, unprecedented at that time in Australia, of direct transformation from 132 kV to 11 kV was adopted. These substations were to be of 60 MVA firm capacity with space available for the future addition of another transformer to enable an increase to 120 MVA later if required. However, the inherent fault capacity available required refined relay protection treatment to prevent widespread damage on fault; and with this done the system as designed and constructed has proved successful in service.

With the first substation installed adjacent to residential areas, the operation of 132 kV air blast circuit breakers with their attendant noise was considered undesirable so small oil volume hydraulically operated circuit breakers (Oerlikon, Switzerland) of 2,000 ampere rating and 8,000 MVA rupturing capacity were installed.

The tap changing transformers were of Tyree manufacture with an ON rating of 30 MVA, an OFB rating of 45 MVA and with each capable of handling a winter peak load of 60 MVA at the Canberra load cycle. They have 18% impedance on 30 MVA to keep the fault value at the 11 kV busbars at a level suitable for the existing 11 kV switchgear on the system.

The transformer connections were ydl and an earthing transformer was used on the 11 kV side which limited the earth fault to 3,000 amperes.

This means simply, that the transformer design was such that each had a capacity of 30 MVA with natural cooling, 45 MVA with forced oil and air cooling, but 60 MVA at the Canberra load cycle in winter when the load peaks. Thus if one transformer was switched out on fault in the winter, the other transformer could carry the whole 60 MVA load.

The transformers are operated each with its own 11 kV feeder load but with a "flip-flop" arrangement so that one transformer automatically takes over the other one's load should it trip out on fault.

The high current on the 11 kV side of the transformers under emergency conditions required two Main Transformer OCB's per transformer as 11 kV OCB's with capacity exceeding 2,000 amperes were unusual. The 11 kV switchboard was of Brush manufacture with 500 MVA rupture rating double busbar and with 16 outgoing feeder circuit breakers each of 800 ampere capacity.

City Zone Substation 132/11 kV

This was situated on land occupied by a former Caravan Park at the foot of Black Mountain and is not only hidden from sight but was given architectural treatment to merge it with the environment as far as possible. It was put into service in July 1967.

Woden Zone Substation 132/11 kV

The existing 66 kV/11 kV zone substation at Woden was converted to 132 kV operation in two stages, the first transformer being put in service in July 1967 and the second in February 1968 when the 66/11 kV transformers and switchgear were removed.

Latham Zone Substation 132/11 kV

This substation situated near Rudall Street, Latham, was constructed in line with the standard adopted for City Zone Substation and went into service in March, 1971, to

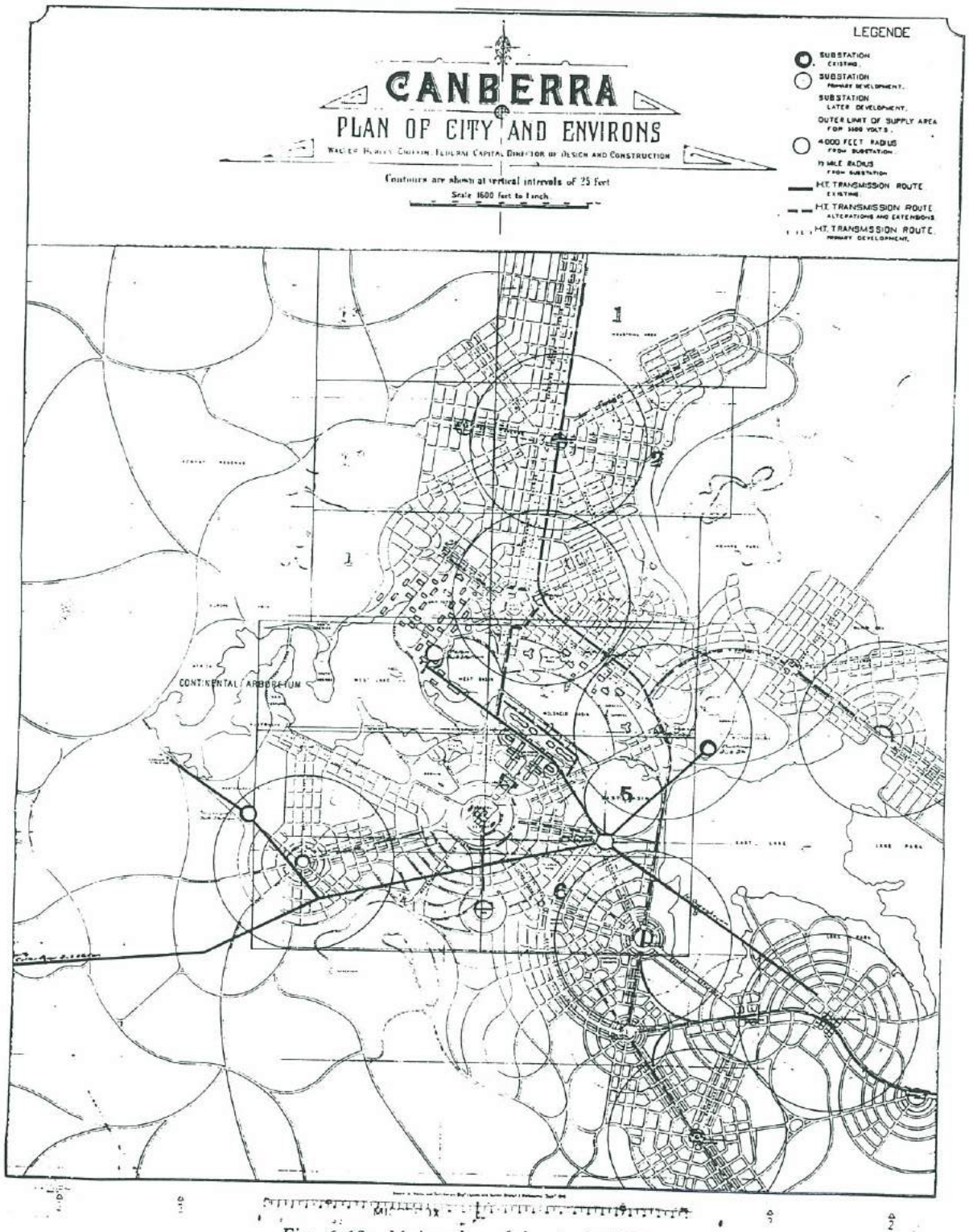


Fig. 6.13: Mains plan of the city in 1918.

supply the growing load in the Belconnen Valley. This was the first substation constructed in that area and connected in to a 132 kV line which had been erected prior to any development in the valley. In 1982 a third 60 MVA transformer was installed making the firm capacity of the substation 120 MVA.

Wanniassa Zone Substation 132/11 kV

This 60 MVA zone substation was constructed adjacent to Athllon Drive, Wanniassa and fully put in service during April, 1975. It was fed from two 132 kV feeders supported on wood poles and emanating from the Woden Zone Substation. In 1981, a third 60 MVA transformer was installed making the firm capacity of the substation 120 MVA.

Belconnen Zone Substation 132/11 kV

This 60 MVA zone substation adjacent to the Belconnen Town Centre was commissioned in April 1977, connected into the same 132 kV feeder as Latham Zone Substation and feeds the surrounding residential areas as well as the Belconnen Town Centre.

This substation saw the first installation in the Territory of the new type of sulphur hexafluoride gas circuit breaker, a type of circuit breaker fairly new to Australia but with many advantages.

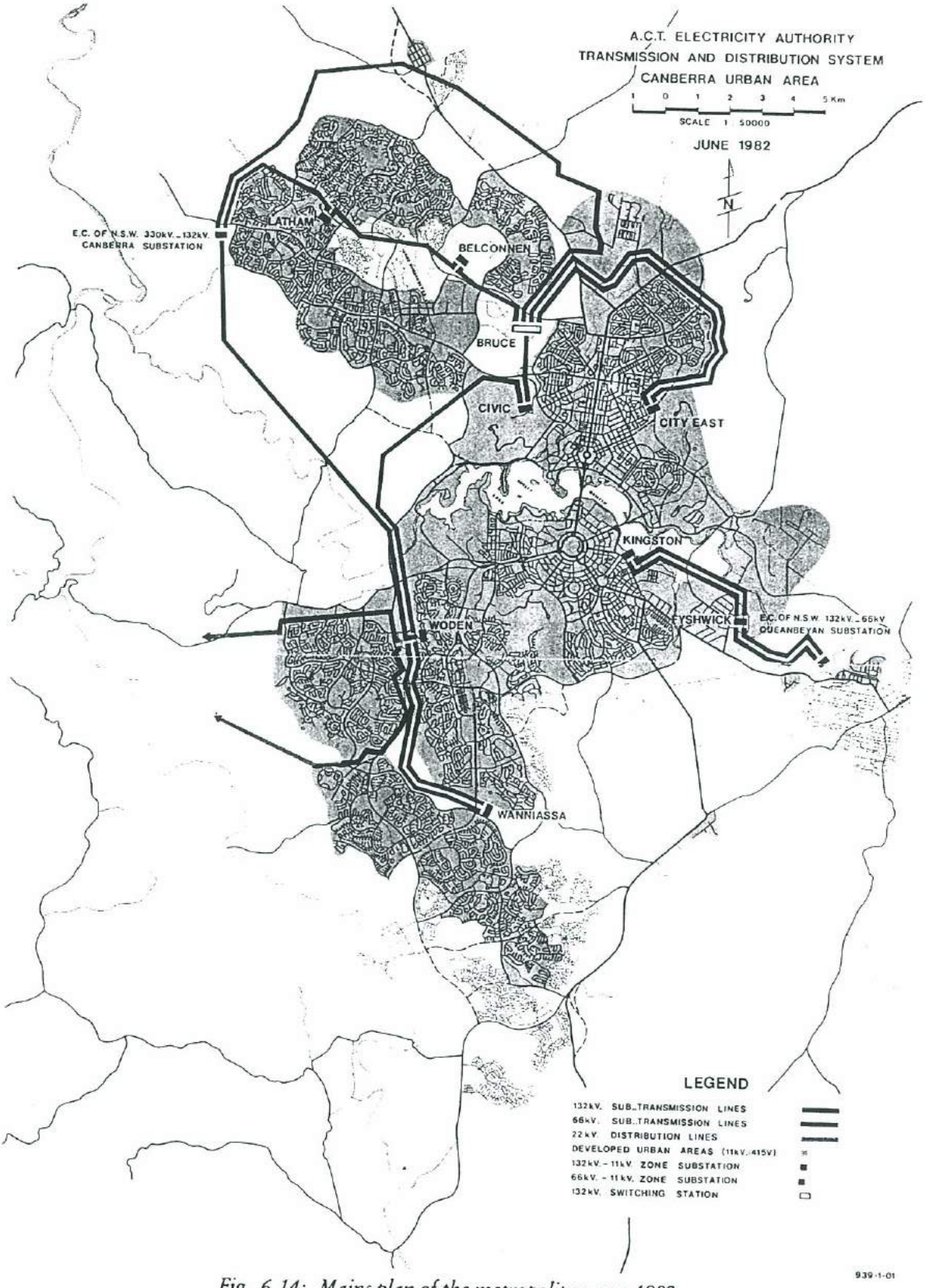


Fig. 6.14: Mains plan of the metropolitan area 1982.

City East Zone Substation

In the middle seventies it was evident that action should be taken to diminish and phase out our demand for bulk electricity from the 66 kV bulk supply point at Oaks Estate near Queanbeyan. With this in view, and to cope with the ever increasing load demands, a switching station was established at Bruce allowing two 132 kV lines each of 260 MVA capacity to be connected through circuit breakers and run to a new zone substation at the foot of Mount Ainslie. This substation would then be available to take new load in the area and to take over the 11 kV supply from the Ainslie 66/11 kV substation.

The substation of 60 MVA firm capacity was commissioned in August 1979 and commenced taking over load from the Ainslie 66/11 kV substation. With this 132 kV substation in service only the original Kingston

substation requires changing from 66 kV to 132 kV supply and this changeover, together with resiting near the Causeway, is now in hand.

The maximum demand at the 1982 winter peak was 485 MW and this was fed from both systems with 431 MW from 132 kV supply and 54 MW from 66 kV supply.

Distribution System

The original distribution voltage at 1915 was the same as the generated voltage, namely 5,000 volts later increased to 5,500 volts with step up transformers at Kingston delivering electricity at 11,000 volts to the Cotter Pumping Station with a later tee off to Mount Stromlo (1922). In fact the 11,000 volt line from Kingston to the Cotter was erected in 1914 and was one of the first lines of that voltage in Australia and the first to use all aluminium wire. The feeders emanated from Kingston Substation and were all overhead except for underground cable in the Parliamentary area.

From 1946 onward a programme was put in hand not only to increase all feeders to 11 kV operation but to underground a considerable length of them. With shortages of capacity and materials this took a long time but on 14 October 1953, bulk supply was taken at 11 kV and all feeders except some undergrounded feeders in the Parliamentary area which operated through auto transformers at 5,500 volts, were converted and operating at 11 kV. The cable was replaced in the Parliamentary area shortly afterward and since then all feeders are operated at 11 kV excepting two 22 kV feeders — one to the Cotter Pumping Station and the Upper Cotter, and one to Tidbinbilla.

With the change to 11,000 volt distribution considerable underground cable was used, with the result to date that 11,000 volt lines are run in less than one third of the streets and nearly one half of them are underground in the City area. As the rate of increase of demand becomes known in each district and funds are available, it is envisaged that they will all be underground before very long, leaving the streets as uncluttered tree-lined avenues as visualised by Walter Burley Griffin.

To the year 1981-82, there were 1,410 route kilometres of distributor in the City area of which 640 kilometres is underground.

Distribution Substations 11,000 Volts to 415/240 Volts

Apart from a few substations in buildings, mainly Parliament House (which also fed East and West Blocks by low voltage cable) and the Cotter Pumping Station, all early distribution substations were of the two pole overhead type.

As the City developed, it was necessary to research all known systems of distribution networks from the viewpoint of economics and operating efficiency, especially for ease of restoration of supply after fault. It was decided to use an open ring system with two 11,000 volt feeds to each substation in the City area and that this system would be the best until motor traffic problems restricted operator movement. Special arrangements for immediate alternate supply were made where this was absolutely essential.

The substations are now a mixture of overhead, one and two pole to 500 kVA, indoor, unlimited capacity, ironclad kiosk to 750 kVA capacity and pad mounted transformers to 750 kVA capacity each used to their best advantage. The total number of substations in service at 30 June 1982 were:—

Indoor Substations	—	150
Kiosk Substations	—	202
Pad Mounted Transformers	—	1048
Overhead Pole Substations	—	1479
Ground Type Substations	—	14
Total	—	2893

Low Voltage Mains 415/240 Volts

Underground cable is used extensively in commercial areas and also for feeders into the domestic reticulation system but rear of lot overhead mains with underground or overhead services to the houses are used in domestic areas. This was used from the outset and was initiated by Walter Burley Griffin. Experience has shown that there are few of the problems of easement and access that are encountered in other places, due to Canberra's system of leasehold tenure of land.

This mains system provides for ease of augmentation and this is essential in Canberra when it is considered that in 1982 it had an average annual usage of 11,258 kWh compared with an Australian average of 6,062 kWh per domestic customer.

The overhead lines are in general mounted on 9.2m wood poles (originally 7.6m) with 1.75m crossarms, the conductors being of copper until recent years and then of aluminium and the standard crossection is 65mm² copper or its equivalent in aluminium.

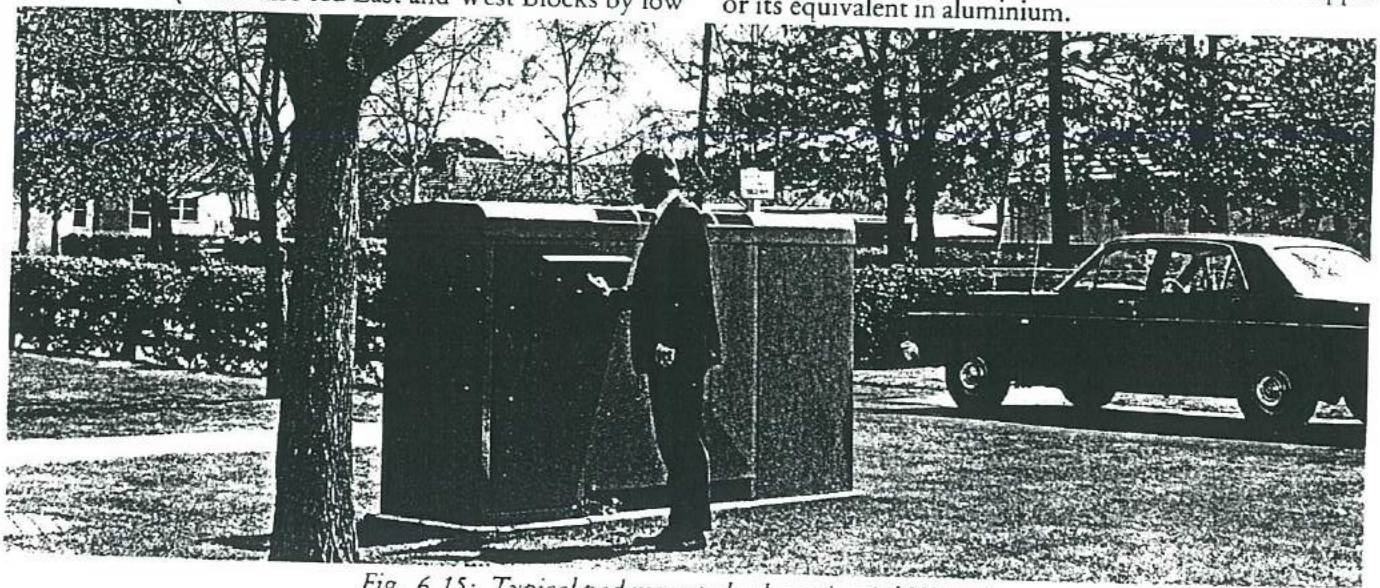


Fig. 6.15: Typical pad mounted sub-station 11kV/415V.

Progress of Electricity Supply in the ACT

At the turn of the century with both Canberra and public Electricity Supply in their infancies, it was decided that electricity with its unpollutive characteristic especially with hydro-electric generation would be the most suitable energy source for the garden City to come. This decision was taken when nearly all the cities of the world relied on coal gas for its distributed energy.

The growth in usage of electricity in the ACT has been tremendous by any standard and far higher than the growth in population. An indication of this growth is given by the following table:

Year	*Population*	*Maximum Demand MW*	*Units Bought MkWh*
1928-1929	6,880	1.04	4.9 (est)
1938-1939	10,800	2.40	12.28
1948-1949	19,639	6.44	30.50
1958-1959	46,072	25.32	103.60
1968-1969	121,662	118.30	459.70
1978-1979	220,000	359.30	1,386.00
1981-1982	230,000	485.00	1,602.00

(Population figures prior to 1959 are for urban areas only. Electricity was subsequently extended to rural areas and the figures for 1959 and later include the whole of the ACT. Queanbeyan, fed from Kingston power house from 1920 to 1939, is not included in the population figures.)

In 1981 the ACT accounted for only 6 per cent of the total demand of 8,011 megawatts on the NSW electricity grid. Half of the ACT's consumption was domestic.

Organisational Responsibility

For many years responsibility for the supply of electricity in Canberra passed from department to department and for most of this time it was carried out in conjunction with all other electrical work such as contracting, day labour and maintenance required by the Commonwealth in the ACT. In fact, even today, a considerable amount of recoverable work, especially maintenance in buildings and undertakings, is still being done by the ACT Electricity Authority.

The movement of responsibility between departments was not as disruptive as it appears as in most cases the work was conducted by the same staff.

All persons in charge of the undertaking have been corporate members of The Institution of Engineers, Australia from its inception and the number of corporate members employed has varied from two to 20.

The following list shows the departments and authorities that have been responsible for electricity supply in the ACT:—

Department of Home Affairs — (Works cell)
(1/1/01-11/11/16);
Department of Works and Railways
(14/11/16-1/1/25);
Federal Capital Commission
(1/1/25-30/4/30);
Department of Works and Railways
(1/5/30-12/4/32);
Department of the Interior
(13/4/32-23/11/38);
Department of Works — (engineering)
(24/11/38-26/4/39);
Department of the Interior
(27/4/39-2/2/45);
Department of Works — (engineering)
(2/2/45-13/7/45);
Department of Works and Housing
(13/7/45-12/10/53);
Department of the Interior
(13/10/53-30/6/63);
ACT Electricity Authority
(1/7/63 —)

Officers in charge

There have been six officers in actual charge of operations since 1914, all of whom have been corporate members of The Institution of Engineers, Australia at one time or another. The dates are as close as can be obtained:

H.P. Moss (visited from Melbourne) (1914-1925);
S.W. Cook (1925-1927);
A.M. Fraser (1927-1944);
W.E. Gray (1944-1952);
H.A. Jones (1952-1975);
W.E. Bolton (1975-).

The ACT Electricity Authority was formed under the ACT Electricity Supply Act No. 72 of 1962 which came into force on 1 July 1963. The first meeting of the Authority was held in the conference room at Civic North Offices on 2 July 1963 when the chairman was delegated to carry on with the day to day management of the undertaking.

The Authority was managed by a full time chairman who was assisted on a part time basis by a representative of the Department administering the Territory and an elected representative of the local Advisory Council, later House of Assembly.

Since 1963, the two full time chairmen have been H.A. Jones (1/7/63-21/1/75) and W.E. Bolton (1975 to date).

Elected representatives of the local government body (no executive functions) have been: J.H. Pead (1/7/63-17/10/67); R.R. O'Keeffe (17/10/67-12/10/70); J.H. Pead (13/10/70-31/10/74); R.P. Vallee (1/11/74-4/7/79); P.R. Whalan (5/7/79-30/6/82) and P.R. Kobold (1/7/82 to date). They have one vote in three on the Authority to decide any business.

The three appointed representatives of the Department since 1963 have been W. McGregor (1/7/63-8/5/70); J.H. Marshall (9/5/70-1/10/74); and W.E. Lawrence (2/10/74-).

Buildings, offices and depots

Shortly after the ACT Electricity Authority was formed in 1963 it was given permissive occupancy of Block 1 Section 8 Kingston, an area comprising about 5.46 ha and fronting Wentworth Avenue. On this land, was the old power station (1915), the Kingston zone substation (1929) and its 11 Kv switch room (1948), the linesman's depot (1958) and the electrical workshop (1956 extended 1967).

The area originally contained not only the power station and the adjacent mechanical fitters shop but a temporary building which initially contained the first joiners shop and other trades, then became the electrical workshop until it was dismantled in 1974. In that year a new stores building was erected on the site and amalgamated with the old fitters shop. The site also contained the first transport depot and fire station, some buildings of which still remain, and three houses by the river now demolished.

As the City grew, it was necessary to decentralise maintenance and construction depots and a first building on the corner of Wakefield Avenue and Limestone Avenue, Ainslie was completed on 8 January 1973.

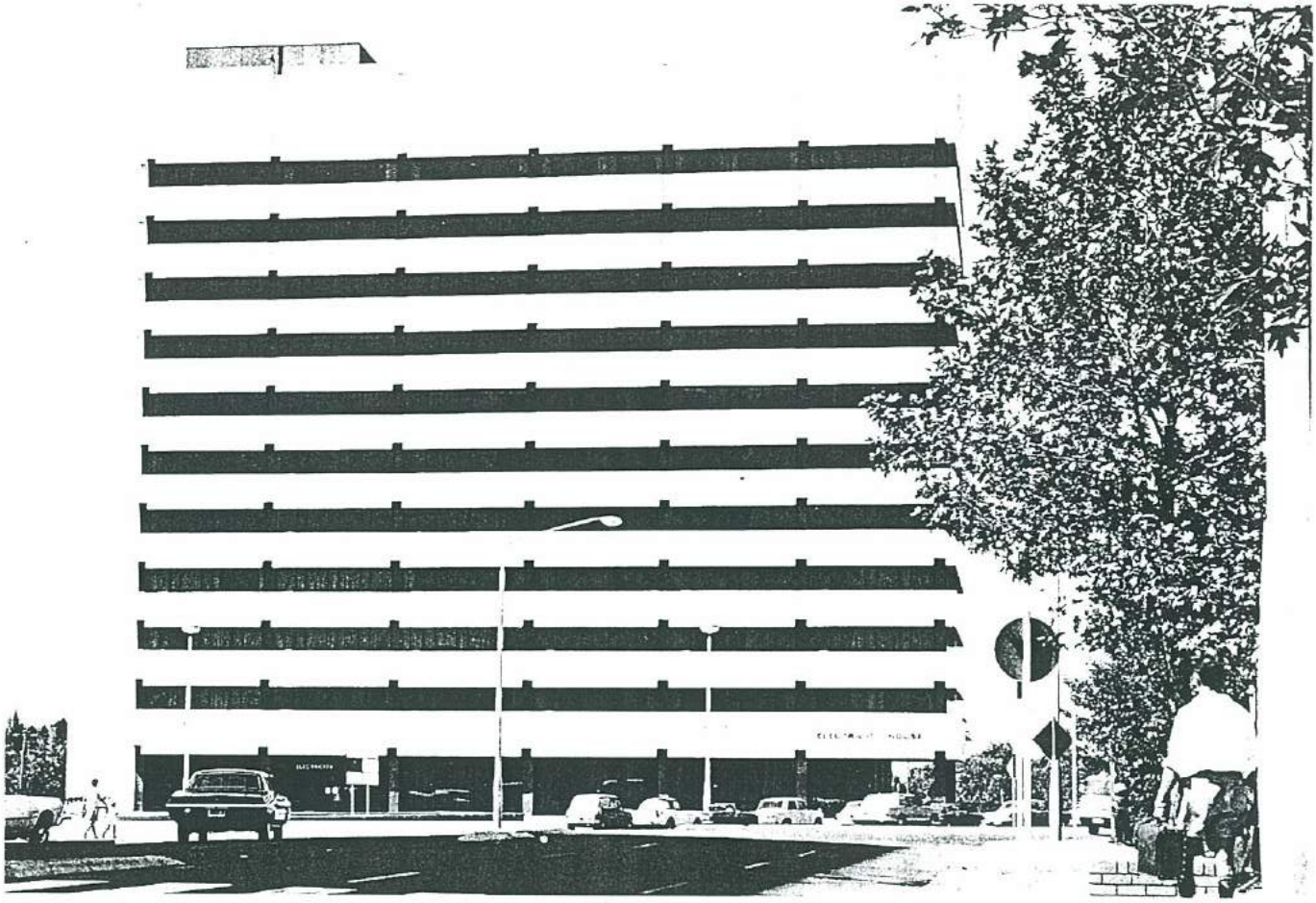


Fig. 6.16: Electricity House, 1982.

Originally the Electric Supply offices were incorporated in the Acton offices which were demolished to make room for extensions to the Royal Canberra Hospital. When the Federal Capital Commission terminated on 30 April, 1930 the engineering and consumer's side were transferred to the Jolimont Offices of the Department of Works and Railways in Alinga Street, City.

The Department of Works was incorporated in the new Department of the Interior on 13 April 1932 and moved shortly afterward back to Acton offices. Electric supply engineering moved from there to No. 2 Unit, Barton with the Department of Works and Housing. The Consumer's records were moved at that time to Jolimont Offices.

On 13 October 1953 the Electric Supply function was re-united in the Department of the Interior at Acton Offices.

On 6 July 1957 the Canberra Electric Supply Branch moved to the Melbourne Building, West Row, Canberra City, into premises rebuilt after a fire which destroyed the Canberra University College Library. The Branch expanded into the top floor of Block 20 Section 1 City and later into Block 3, Section 3 of Hobart Place.

The growth of the function and lack of availability of office space decided the ACT Electricity Authority to obtain a Crown Lease of Block 1 Section 12 City and to build Electricity House, combining offices, a large distribution substation and a distribution control centre.

The tender of $2,701,658 of Civil and Civic Pty Ltd was accepted for the construction of Electricity House on 30 May 1967 to plans and specifications produced by Peddle Thorpe and Walker Architects. Rankine and Hill were the engineering consultants and Rider, Hunt and Partners were the quantity surveyors.

The building was completed at slightly less than the tender price and occupied on 20 January, 1969.

The building has a gross floor area of 11,220m² and should be large enough for a headquarters building for the foreseeable future. For customer convenience a small office with demonstration theatre was opened in Woden Plaza on 19 September, 1972, and a small office was opened in Belconnen Mall on 22 August, 1978.

Electricity supply in Canberra has now reached a size never contemplated originally, with a maximum demand approaching 500 Megawatts and a total annual revenue of $56.0 million and rising. It is a large organisations by any standard.

It is now run completely on behalf of its customers with staff paid by its customers and is sensitive to its customer's requirements.

The technical equipment and the accommodation accords with the best modern practice and the outlook of those guiding its destiny is progressive.

Attracted by the high price of oil, reticulated gas is now making its appearance in the City and although it will compete mainly with fuel oil, it will also have some effect in moderating the demand for electricity in heating homes in the winter.

With all sources of energy being used as a taxing medium the economic pendulum will swing back and forth but, no matter what happens, electricity will continue to be the major source of energy for Canberra and its life blood.

Acknowledgement

The author is grateful for the assistance of the Chairman of the ACT Electricity Authority, Mr W.F. Bolton, and for the opportunity to use information obtained from the records and station log books of the Authority in the preparation of this chapter.

Extract from

KINGSTON FORESHORE SITE
CULTURAL MAPPING STUDY
VOLUME 1: CULTURAL MAPPING

for

THE INTERIM KINGSTON FORESHORE
DEVELOPMENT AUTHORITY

FREEMAN COLLETT & PARTNERS
CONSERVATION ARCHITECTS& PLANNERS - CANBERRA

June 1996

2.2 POWER FOR THE FEDERAL CAPITAL

The search for the site for Australia's proposed new Federal capital proceeded at a time when one of the most important questions for any large city was the provision of an adequate source of power for lighting and other public and private needs. As early as 1903, T Pridham, an engineer with the NSW Public Works Department, suggested harnessing the waters of the Snowy River to supply electric power to the then favoured site for the capital at Dalgety in NSW. Pridham advocated a large hydro-electric installation as the way to provide sufficient electric power for city tramways, street lighting and heating, industrial undertakings, a railway from Cooma and even a tramway to Mount Kosciusko. One year later

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6 C.E.T Newman, The Spirit of the Wharf, A & R, Sydney 1961 p211
7 NSW Votes & Proceedings vol 5 Appendix 2, Report of the Stock and Brands Branch
8 Queanbeyan Observer 5 May 1903
9 Queanbeyan Age 23 October, 2 November 1906

an independent investigation by Charles Robert Scrivener, a senior surveyor in the NSW Department of Lands, endorsed Pridham's findings and the site at Dalgety.

The early schemes put forward by Pridham and Scrivener were overtaken by the decision to select the Canberra-Yass area as the site for the federal capital in late 1908. Commonwealth officials sought a source of power that was closer to the chosen site than the Snowy River, and which would therefore prove less costly. In October 1908 , W.M. Corin, an electrical engineer in the NSW Public Works Department, reported favourably on the Cotter River as a source of both water and of hydro-electric power for a city of 50,000 population. However the Advisory Board for the Federal capital was not at all confident about the Cotter's potential. In June 1909, the Board reported that:

> *In view of the maximum water consumption during drought and with the minimum flow during successive years of low rainfall, it cannot be anticipated with certainty that the Cotter supply would meet the demands for water and power for a population greater than 50,000 and for manufacturing purposes of any magnitude, should such ever be proposed within the Territory.*

The Commonwealth, meanwhile, had not lost sight of the possibilities of the Snowy River as a source of hydro-electric power for the Federal Capital. As part of the Seat of Government Act of January 1910, the NSW Government agreed to allow the Commonwealth the right to generate electricity free of charge from the Snowy River. With no imminent possibility of using hydro-electricity, government officials began to cast around for alternative sources for the federal capital. During 1910-11, the Department of Home Affairs actively considered a high-pressure reticulated gas system for the future city. The principal purpose of the system was to provide lighting for Canberra's streets, but it was also to be used for domestic cooking, heating and presumably lighting. At that time, advances in gas lighting technology had made it the equal of its electric powered rival, and people were beginning to appreciate the superiority of gas over electricity for cooking.

Initially Canberra's founders considered allowing the construction of a number of small scale electricity generating plants throughout the city area. For reasons of

reliability and economy the city fathers soon decided upon one centralised power system that would be set up and operated solely by the federal government. It remains one of the great, though almost unrecognised, achievements of the city founders that Canberra's power supply was planned from the start.

At the beginning of June 1911, the Department of Home Affairs commissioned F.W. Clements, Chief Engineer and General Manager of the Melbourne Electric Supply Company, to report on a centralised electric power system for the proposed federal capital. By that time, Colonel Percy Owen, the Commonwealth Director-General of Works, had already decided that the power station should be erected on the banks of the Molonglo River, though the exact position had yet to be fixed. Clements was instructed to draw up a scheme for Canberra's power supplies based upon a projected population for the city of 25,000 by the year 1932; the earlier projections of an eventual population for Canberra of 50,000 were now thought to be wildly extravagant. The figure of 25,000 conformed to that specified in the recently announced design competition for the federal capital.

Clements submitted his report to Owen on 10 July 1911. In it he calculated that to cater for a population of 25,000 Canberra's power supply would have to be of sufficient capacity to cope with a maximum load of 2,800 kilowatts (kW). Because the Department felt that it could not select the permanent site for the power house until the design for the city had been determined, the first generator could be set up in a cheap, temporary building and later moved into a permanent installation that would house the full complement of generating machinery.

Clements was well aware of the need to take aesthetic considerations into account in his report. Clements's scheme was swiftly accepted by the government as the blue print for Canberra's power supply.

There was one major problem arising from Clements's report and that was its timing. It was commissioned only a few weeks after the announcement in April-May 1911 of the design competition for the federal capital, and was accepted by the federal government more than six months before the competition was scheduled to close. As the government was determined to press on with the laying of the city's foundations and as a power supply was an essential prerequisite for construction and habitation,

senior government officials were faced with the problem of siting the power station without the benefit of a city plan. Owen and his colleagues sensibly decided to select a provisional site, with only a temporary structure to be erected upon it.

By 7 July 1911, three days before Clements submitted his report, Owen had pinpointed the site for the temporary power station. It was an area of about 20 acres on the southern bank of the Molonglo river near its junction with a small creek, at a point where a gauging weir was to be built across the river. The purpose of the weir was to measure the Molonglo's flow, as part of the general assessment of the water resources of the new federal territory. Approval to build the weir had been given on 3 February 1911. To Owen and his colleagues the site presented an obvious advantage for power generating equipment, as the pool created by the weir would, they hoped, provide a constant and adequate water supply for the power station's boilers.

After the temporary location had been chosen, there was a strong feeling among senior government officials, such as David Miller, that, until the design for the city had been decided no permanent structures should be erected on the site. Scrivener, by then Director of Commonwealth Lands and Surveys, went even further. He declared that:

> *Whatever the design of the City, the site is unsuitable for either permanent Power House or Kilns if the beauty of the ultimate City is to be a factor of importance.*

At length, in November 1911, King O'Malley approved the temporary site, on condition that no permanent buildings would be erected on it, the site would be kept absolutely free from pollution and there would be no interference with the contours of the site.

Meanwhile, the [first] Commonwealth Government Architect, John Smith Murdoch, began drawing up plans for the temporary power house. Back in August, Owen had envisaged the temporary structure as merely a galvanised iron shed, which would house the first generator and its associated equipment. The difficulty was that the equipment needed for one generator was quite substantial and required an iron shed of some considerable size. For Murdoch, there was an added problem in that he had to estimate how long the structure would serve as a temporary installation. It may well have

turned out that the building would serve as Canberra's power house for some years and would therefore have to be large enough to accommodate all or most of the equipment detailed in Clements report. But to indicate its temporary nature, the building was to be clad with galvanised iron.

On 23 May 1912, the Board judging the design competition announced its decision in favour of a design by the Chicago architect, Walter Burley Griffin. Unfortunately for Owen, Griffin did not specify a site for the power house in his winning entry, although it was clear that the temporary site did not fit in at all with his ideas for that section of the city. Moreover, the only site that seemed suitable for a power house in Griffin's plan was a designated industrial area where the suburb of Dickson now exists. This was far from any suitable supplies of water and would require a much greater length of railway line to service it. Griffin's plan, along with those of the other prize-winners in the competition, was soon referred to a Board appointed to work out how to implement the best features of each plan in the building of the city. Under the chairmanship of Miller, the so-called 'departmental board' was dominated by engineers and surveyors. Murdoch, the designer of the power house, was the board's lone architect. In November, the board presented its own plan, largely based on Griffin's design, and this showed Canberra's power station firmly located on what had formerly been regarded as its temporary site.

Refer to Sequential Plan 2
Appendix 2, Volume 2

The re-orientation towards a [more] permanent structure may have been reflected in the decision to use bricks, instead of galvanised iron, to clad the building. Bricks would have been a more permanent and aesthetic building material. In the event, 1.5 million bricks were manufactured for the power house, but the local shale proved unsuitable for the dry-press process by which the bricks were made. Perhaps fortunately the bricks disintegrated before they could be used. For a cladding material, the power house builders then turned to unreinforced concrete made with river gravel. It was cheaper than brick and aesthetically superior to galvanised iron.

Preliminary work for the power house commenced almost immediately upon presentation of the Departmental Board's plan. The barrier that ownership of Duntroon Estate had formerly posed to work on the

structure had been resolved by the government's acquisition of the property on 27 July 1912.

In February 1913, Federal Cabinet formally ratified the board's plan for Canberra, thus confirming as permanent the site for the power house.
The determination of the permanent site was made well before Griffin's arrival in Australia and represented a most significant pre-emption of his detailed plans for the federal capital.

However, it was not until 11 April 1913 that Duntroon Estate, Holding No. 21 was finally transferred to the Commonwealth. The site for the power house lay on Robert Campbell's 5,000 acre grant by purchase, south of the Molonglo River at its junction with Spring Creek. Spring Creek drained the Black Springs holdings of the Campbell family of Duntroon and the Sheedy family's Narrabundah property near Mugga Mugga Hill.

The Departmental Board's proposed plan was more economical than Griffin's since it concentrated development south of the Molonglo River. Overseas, Patrick Abercrombie condemned the new plan in the columns of the *Town Planning Review*. Although the Departmental Board's plan was accepted as the official plan, a change of government led to the boards dismissal in October 1913 and the appointment of Griffin as Federal Director of Design and Construction[10].

2.3 WALTER BURLEY GRIFFIN 1913-1920

Colonel David Miller, Secretary of State, and first administrator of the new federal capital, was responsible for two significant events; the selection of horticulturist Thomas Charles George Weston in 1911 and formally proposing that a world wide competition be held for the design of Canberra[11]. Weston and Australian town planner John Sulman, who had migrated to Australia some twenty five years before, were to have a significant impact on the growth of Canberra, and of Kingston.

Griffin's plan for the Central area in 1911, and the Official Plan of 1913, endorsed the suggestion made by surveyor Scrivener in 1909 to establish an artificial lake by damming the Molonglo river to the west of the City Area.

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10 K.F. Fischer, Canberra: Myths and Models, Institute of Asian Affairs, Hamburg, 1984 p20

11 K.F. Fischer, p17

Griffin's plan envisaged a chain of five water features, the three central lakes being designed as formal basins. The two halves of the City were to be connected by road and rail links which emphasised the geometry of the plan and the central water features. The major manufacturing sections of the city were to be located next to railway marshalling yards to the north of the city, near Mt Ainslie. The rail link from the City connected the Market Centre and Main Station (at Russell) with the main line from the south via a raised 'causeway' or dam which created an upper lake to the east[12]. This rail link was seen as integral to the successful construction of the city and the future transport system.

The railway from Queanbeyan to Canberra was originally intended to be of light construction but a petition to King O'Malley for a permanent line was successful. In June 1913, workmen began construction of the railway extension from Queanbeyan[13]. Griffin arrived in Australia in August 1913 to find construction on the power house well under way. Failing to have the building recognised as temporary he advocated an entirely different site on the northern shore of his East Basin, next to the Causeway.

Refer to Sequential Plan 4
Appendix 2, Volume 2

The need for rail sidings to service the power station and provide access to government stores was recognised by the Departmental Board when two lines were constructed on either side of the power house site. The first goods train pulled into a temporary siding at the power house on 25 May 1914[14]. By this stage building of the subsidiary structures was well under way. To the south-east of the power house, a large engineers workshop was erected using galvanised iron. Behind it were three other galvanised iron sheds; a blacksmith's shop, an electrical store and workshop , and a joiner's shop. A range of smaller galvanised iron buildings served as storage sheds, stables and offices.

An early consideration was the need to provide at least temporary accommodation for staff at the power house since there was little accommodation available in the federal capital. Temporary quarters had been erected at Acton in 1912 for both single and married staff employed by the Commonwealth. Conditions at the power house were more severe given the open nature of the terrain

12 K.F. Fischer, pp 22-25
13 J. Gibbney, Canberra 1913-1953, AGPS, 1988 p15
14 J. Gibbney, p15

created by the action of grazing on the relatively treeless paddocks along the Molonglo River which were formerly part of Portion 36 on Duntroon Estate, in the Parish of Canberra.

A new mess hall was operating by May 1914 alongside the engineers quarters which were established opposite the power house[15].

The onset of the First World War in 1914 caused repeated budget cuts. As an American, Griffin's position was tenuous until a Royal Commission of Enquiry found that necessary 'information and assistance were being withheld' from Griffin[16]. In mid 1915 the power house and generating equipment were at last completed[17]. (Plates 1 and 2)

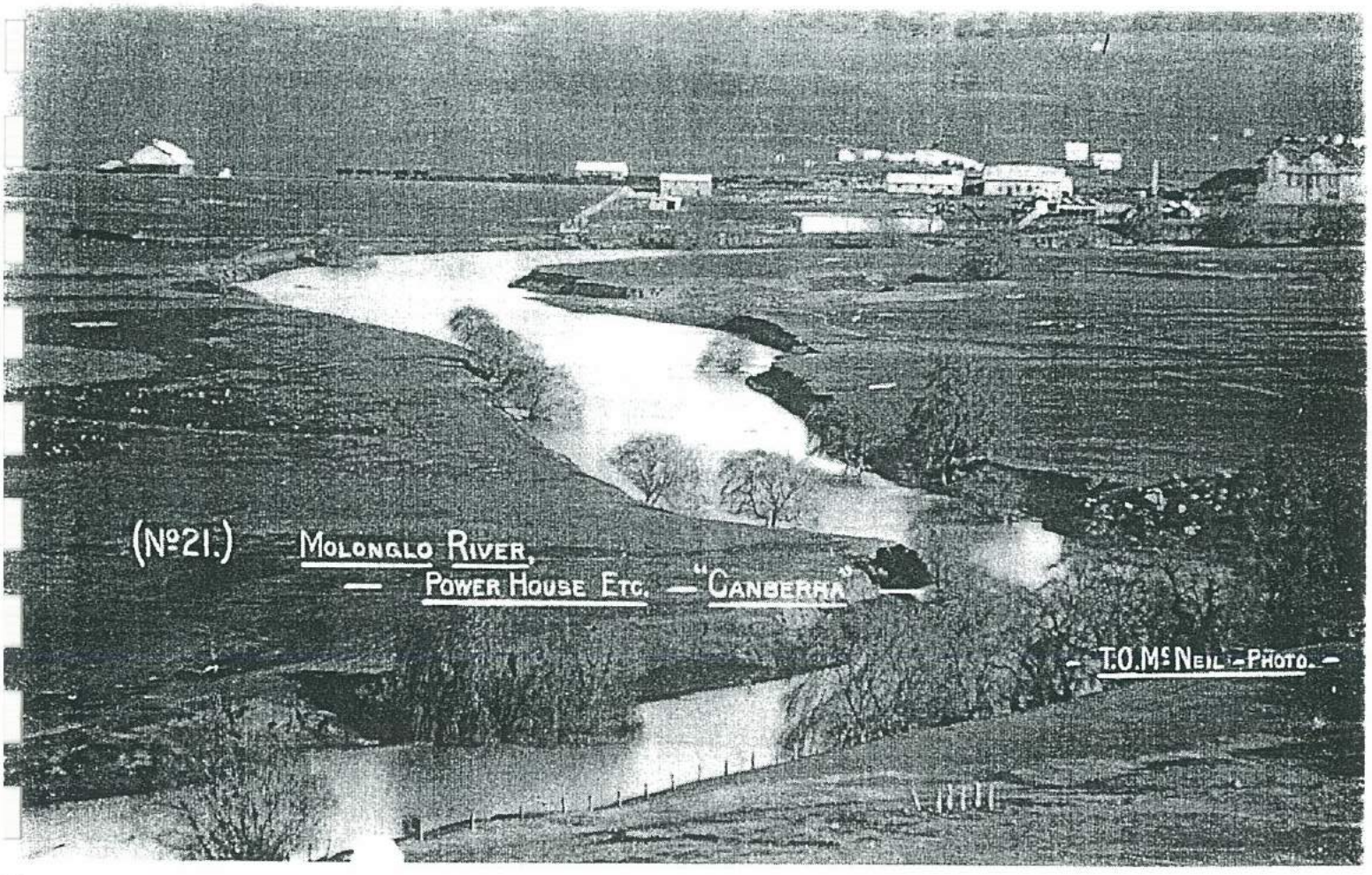

Plate 1: The Power House complex from Mt Pleasant, Duntroon, c1915. Temporary sawmill, services, storage, fitters' workshops, Swagger camp, St Paul's Church and the single men's camp to the south of the rail sidings.
Source: Paul Griffiths, 1996, TO McNeil photograph

15 J. Gibbney, p19
16 K.F. Fischer, p34
17 Report of the Royal Commission on Federal Capital Administration, Report No 6, Water supply, Power and Miscellaneous, Parliamentary Paper no.16 of 1917, p17

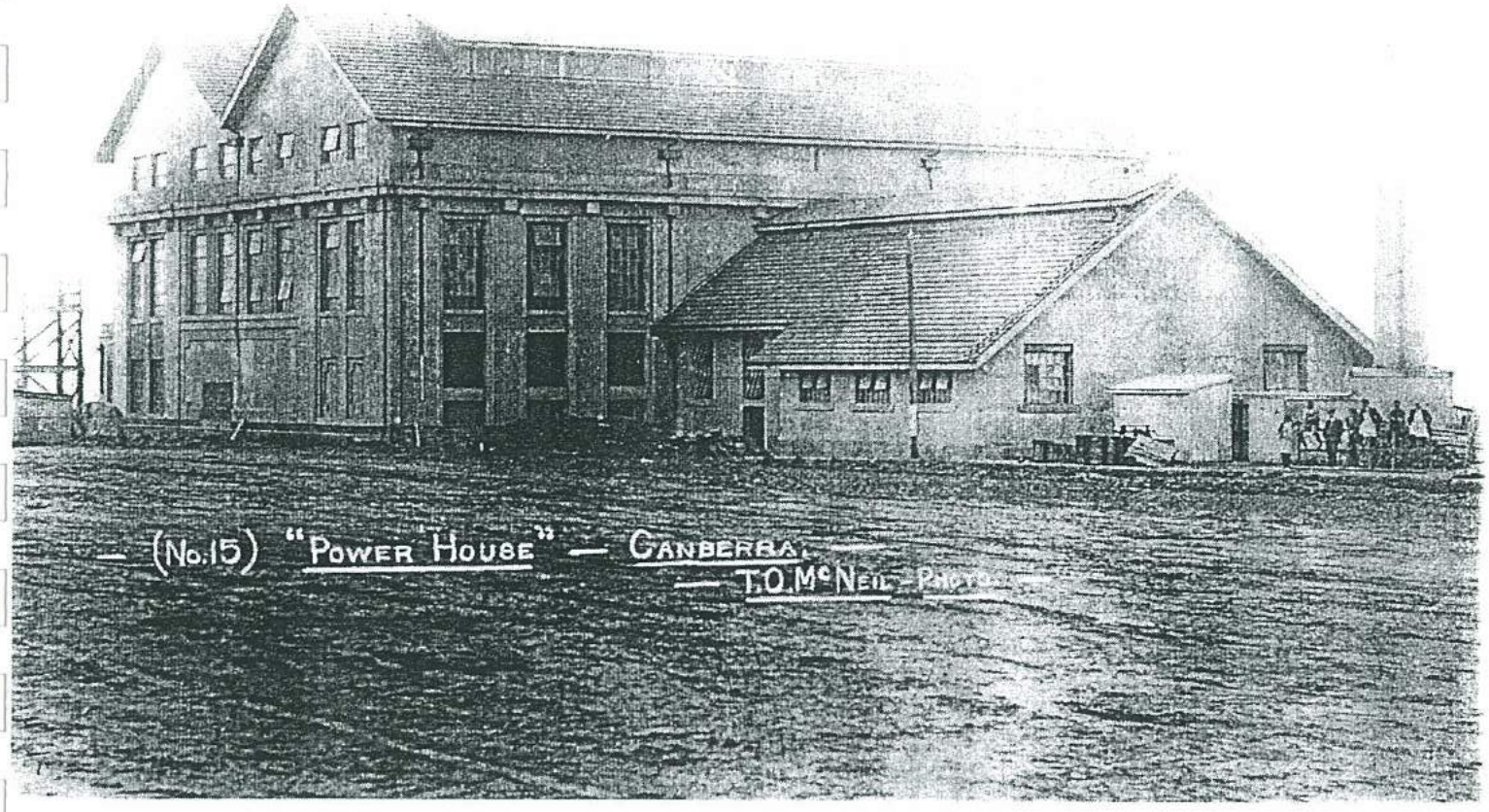

Plate 2: The Power House from the south, c1915. Note the telephone connection, timber power distribution tower and the levelling of the ground for the rail sidings.
Source: Paul Griffiths, 1996, TO McNeil photograph

Despite the supplanting of almost all the steam engines by the new power house, the demand for power in Canberra proved to be less than Owen and his engineering colleagues had estimated. Expenses far outstripped income. In the financial year 1916-17, for example, expenses amounted to £14,262/4/3 and income to only £4,282/1/2. In the first nine months of the succeeding year, expenditure was reduced to £8,628/16/8, but income also declined to £2,900/18/-. This imbalance produced two effects. Firstly the Department of Home Affairs was forced to charge a relatively high price to supply electricity to its consumers. The second main outcome of the poor demand was the extension of the line to Queanbeyan. It was not until May 1920 that work commenced on extending the power line from the Molonglo Defence Camp [erected in 1918 to accommodate other nationals who might interfere with the war effort] *to Queanbeyan. Electricity was first supplied to the town* [of Queanbeyan] *on 2 September of that year.*

Refer to Sequential Plan 10 Appendix 2, Volume 2

Although by 1916 Griffin appears to have acquiesced in the matter of the power station site[18] the water features remained major elements in the geometry of his plan. One important element implemented by Griffin was the construction of a branch line from Canberra Station along the line of his 'causeway', between the East Basin and Eastlake. A diversion canal was cut to divert the water northwards into the Molonglo River and a low causeway constructed across Jerrabomberra Creek. Although funds were made available for this in October 1916, and the bridge built that year, the line to Civic Centre was not finished until 1921[19].

Refer to Sequential Plans 8, 9 and 10
Appendix 2, Volume 2

The impact of Thomas Weston, officer in charge of afforestation 1913-1926, was first felt at Kingston between 1919 and 1920 when a wind-break was planted round the power house[20] similar to that at Haig Park, north of the Molonglo River. Weston, it seems, hated the cold weather, 'particularly the howling wind'[21]. Planting records for 1919-1923 indicate that at least 1,420 *Pinus insignis (radiata)* and were planted along Interlake (Wentworth) Avenue and what was an extension of today's Dawes Street. Planting records, photographs and the remaining remnant indicate that the windbreak consisted of rows; outer rows of acacias, an inner row of eucalypts and four rows of radiata pines, two on each side of the centre row. Trees were planted closely at 10' centres to create a screening effect. The windbreak was clearly established in the central dividing section of Griffin's 'Eastlake Boulevard' but did not reflect the future geometry of the underlying Grevillea Place west of the power house[22]. The location of the windbreak suggests that there were two intentions. Firstly to cut down the impact of the prevailing winds, and secondly to provide a screen between the power house and residential development to the south west.

Although Griffin's contract was due to expire in October 1919 his employment was extended to 1920 in view of the aftermath of the war. In October 1920 Griffin was invited to join a new advisory committee on federal capital construction. Griffin resigned his position in December 1920. When the Federal Capital Advisory Committee was appointed in January 1921 Griffin's name was absent[23].

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18 Jones, 'Electricity Supply in the ACT', transcript of address, 21 May 1970, p2; Jones, 'Electricity', p.129
19 J. Gibbney, p49
20 Anne Gugler 18/5/96
21 Verona Burgess CT 20/4/96 p C5
22 AA Series CP 209/1 Item B13 Part 1 Planting records 1912-1923 and Detail Plan Power House Series A 192/1 Item FCL1922/1110

Competition Eligibility

Entrants are encouraged to put together integrated teams, drawn from the professions below, and the urban development industry.

The team Principal must (as of 17 February 1997) either belong to one of the following:

- Australian Institute of Landscape Architects;
- Environment Institute of Australia;
- Institution of Engineers, Australia;
- Royal Australian Institute of Architects;
- Royal Australian Planning Institute;

and/or

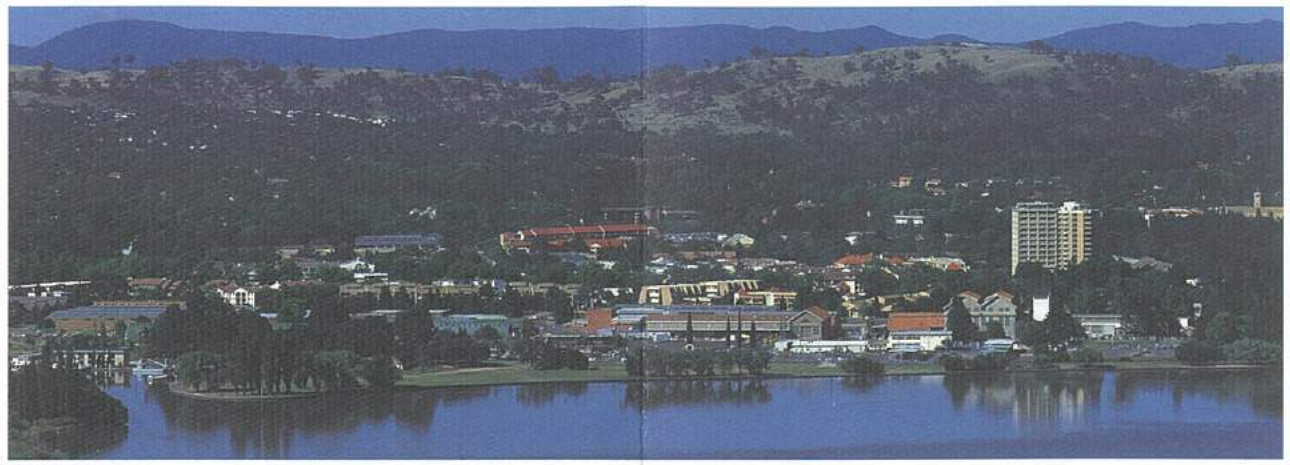
be registered in Australia as a practitioner in architecture, engineering, environment, lansdcape architecture or town planning.

Ineligibility

Ineligible to enter are:

- members of the ACT House of Assembly (and their staff);
- the Commonwealth Minister for Sport, Territories and Local Government, and the Commonwealth Minister for Administrative Services (and their staff);
- current and past members of the Interim Kingston Foreshore Development Authority and the National Capital Authority;
- any ACT and Commonwealth staff who have provided advice or been directly involved in the process of the competition;
- the Competition's professional adviser;
- the principal consultant for the preparation of the Interim Management Plan for Kingston Foreshore;
- any other person who the Registrar believes could obtain an unfair advantage in the Competition because they are closely related to, or are a professional partner/employee or associate of any of the above.

This form along with a cheque or money order for $75, is to be posted to the Registrar, Kingston Foreshore Competition of Ideas. Details over.



Timetable

27 January 1997
Competition of Ideas launched; Brief forwarded to registered teams from 28 January.

17 February 1997
Final day for registration but **early** registration is strongly encouraged.

30 April 1997
Final day to lodge submissions.

June 1997
Winners announced.

The Jury

The Competition Jury comprises:
Ken Woolley AM, BArch, LFRAIA (Chair)
Rob Adams, BArch, MUrbDes
Margaret Hendry OAM, Dip Landscape Design
Denis Page, FICAA, FICD, Chair, Canberra Business Council
Cathy Santamaria
Bruce Sinclair AM, BEng (Civil), FIEA

The Jury's decision will be final, binding and conclusive.

The prize money

The Jury will choose up to three winners.

It will decide the allocation of prize money based on the relative merits of the ideas of the winners.

On the understanding that there are three winners of merit, the first prize will be *up to* $70,000; second prize a *minimum* of $30,000 and third prize a *minimum* of $20,000.

Inquiries

All inquiries about the Competition must be directed to:

Registrar
Kingston Foreshore Competition of Ideas
Interim Kingston Foreshore Development Authority
PO Box 975
Civic Square ACT 2608

Tel: (+61) 06 207 5322
Fax: (+61) 06 205 0386

Kingston
Foreshore Development

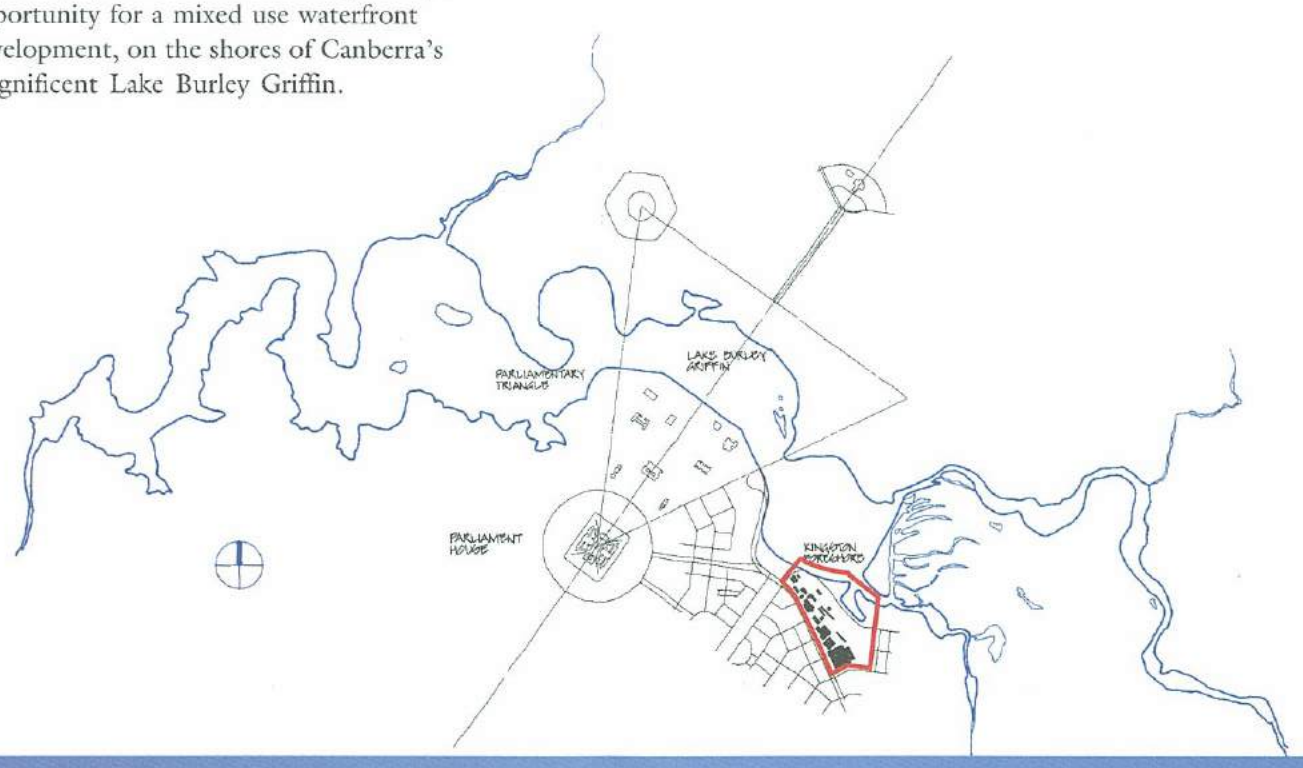
Competition of Ideas

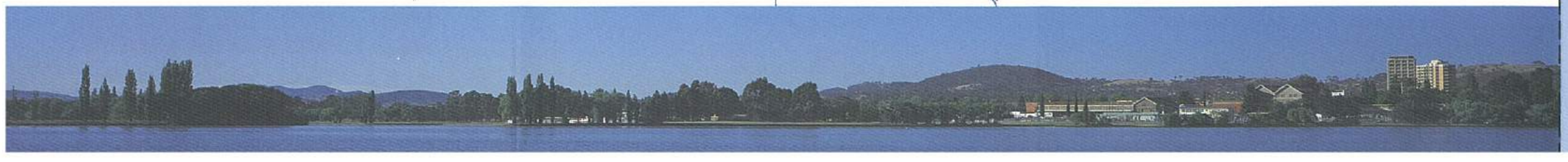
A project of the ACT Government

KINGSTON FORESHORE IS CANBERRA'S PREMIER REDEVELOPMENT SITE

- North facing with prime water frontage.
- 37 hectares of former industrial land (largely disused buildings, old Powerhouse site heritage listed).
- Within arms reach of the Parliamentary Triangle's national icons and anchor attractions.
- A short walk from the cosmopolitan retail/residential centres of Kingston and Manuka.

In short, a plum location offering a unique opportunity for a mixed use waterfront development, on the shores of Canberra's magnificent Lake Burley Griffin.





COMPETITION OF IDEAS

Stage I of the redevelopment plan is a Competition of Ideas. The ACT Government invites creative, realisable ideas from Australia's designers and the urban development industry.

The competition winners will receive substantial prize money and publicity.

All entries will be publicly displayed.

Should the ACT Government later decide to progress to Stage II, Stage I winners will be invited to develop their ideas further; subject to those ideas being critically reviewed to verify their practicability, financial viability and environmental sustainability.

Copyright of all ideas will remain with the original authors; future use of designs to be negotiated.

REGISTERING FOR THE KINGSTON FORESHORE COMPETITION OF IDEAS

Name _____

Company _____

Address _____

_____

Tel _____

Fax _____

I wish to register an application, or (in the case of a team) my team's application, for the Kingston Foreshore Competition of Ideas. I understand that the Competition Brief package will be forwarded to me from 28 January 1997.

I attach a complete list of the members of my team; their professional details and principal occupations.

I hereby confirm that neither I nor any member of my team has any association as described in the conditions of 'Ineligibility' overleaf.

Further, I attach documentary evidence to verify my own eligibility as the Principal of this team, according to the terms of "Eligibility' overleaf.

I further accept that should I or any member of my team later be found by the Registrar, Kingston Foreshore Competition of Ideas, to be 'Ineligible', or attempt to influence the Jury's assessment, or receive any assistance from any persons referred to in the 'Ineligibility' clause overleaf, then we will be automatically disqualified from the Competition.

I further accept that **all** inquiries must be addressed to the Registar, Kingston Foreshore Competition of Ideas.

I acknowledge that the attached cheque or money order for $75 (made out to the Kingston Foreshore Competition of Ideas) is non-refundable.

Signed _____ Date _____

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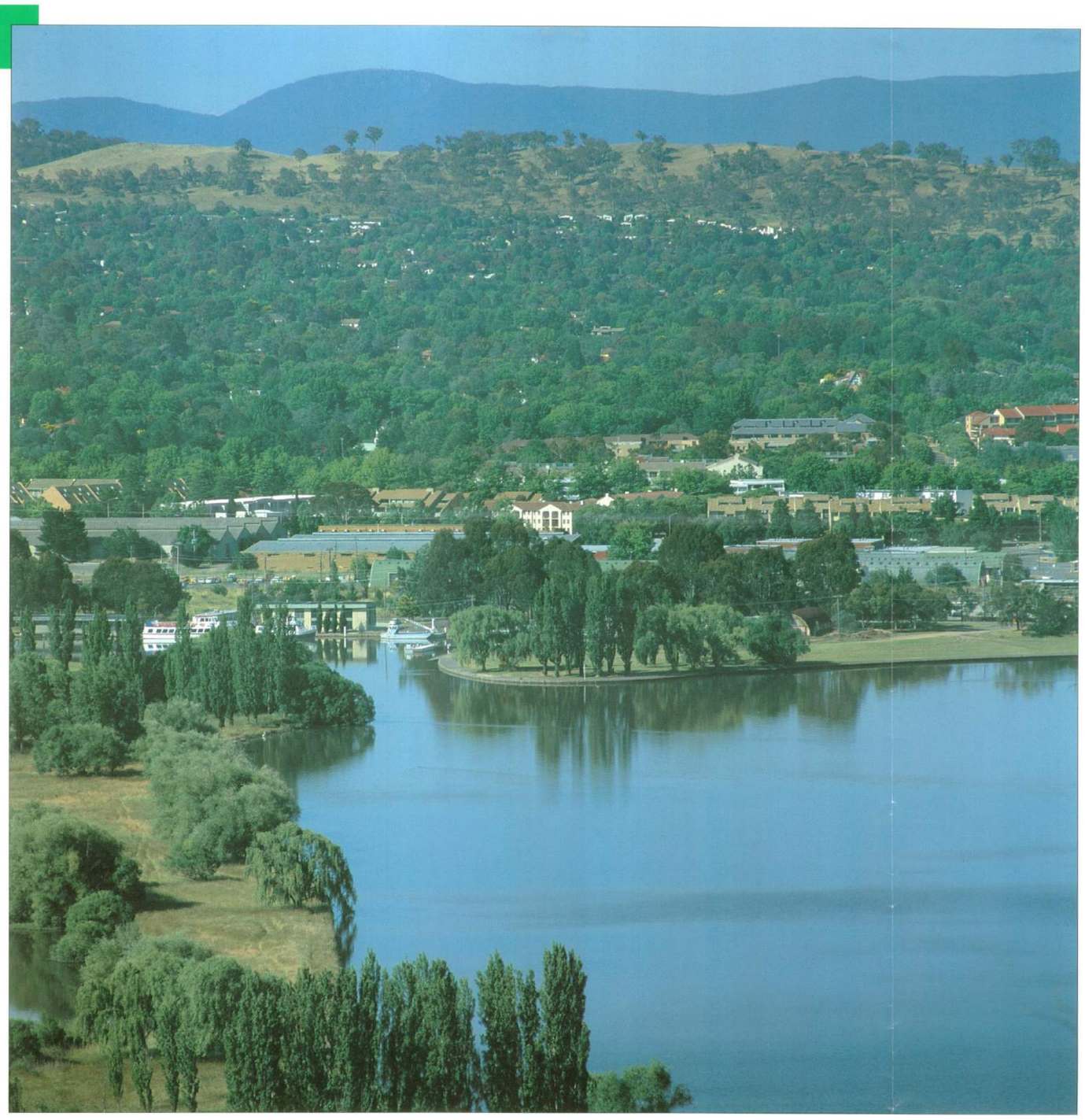

1 Kingston Foreshore, including the Boat Harbour, from the north east.

2 Inside the former Powerhouse.

3 View across Lake Burley Griffin, showing the heritage-listed Powerhouse (right of centre) and Bulk Store (centre). The high rise residential buildings in the background are part of the adjoining urban fabric.

4 The view from the south, showing East Basin of Lake Burley Griffin, Jerrabomberra Wetlands (foreground) Kingston Foreshore (middle left), Parliament House (upper centre) and Kings Avenue bridge (right).

5 Site detail. Currently much of the site is industrial. In the background are the Bulk Store and the Powerhouse.

KINGSTON
FORESHORE DEVELOPMENT

2

3

4

5

LEGEND

- Subject boundary
- Buildings within subject boundary

Drawn by ACT Mapping Office

0 25 50 75 100 125m
Scale 1:2500

KINGSTON
FORESHORE DEVELOPMENT